

**CPC****COOPERATIVE PATENT CLASSIFICATION****G03F**

**PHOTOMECHANICAL PRODUCTION OF TEXTURED OR PATTERNED SURFACES, e.g. FOR PRINTING, FOR PROCESSING OF SEMICONDUCTOR DEVICES; MATERIALS THEREFOR; ORIGINALS THEREFOR; APPARATUS SPECIALLY ADAPTED THEREFOR;**(phototypographic composing devices [B41B](#); photosensitive materials or processes for photographic purposes [G03C](#); electrophotography, sensitive layers or processes therefor [G03G](#))

**NOTE**

In this subclass, the following terms or expressions are used with the meanings indicated :

- "photosensitive" means not only sensitive to electro-magnetic radiation but also to corpuscular radiation;
- "photosensitive compositions" covers photosensitive substances, e.g. quinonediazides, and, if applicable, binders or additives;
- "photosensitive materials" covers the photosensitive compositions, e.g. photoresists, the bases carrying them and, if applicable, auxiliary layers.

**WARNING**

The following IPC groups are not used in the CPC system. Subject matter covered by these groups is classified in the following CPC groups :

<a href="#">G03F 3/08</a>	covered by	<a href="#">H04N 1/46</a>
<a href="#">G03F 7/207</a>	"	<a href="#">G03F 7/20</a>
<a href="#">G03F 7/23</a>	"	<a href="#">G03F 7/22</a>
<a href="#">G03F 9/02</a>	"	<a href="#">G03F 9/00</a>

**G03F 1/00**

**Originals for photomechanical production of textured or patterned surfaces, e.g., masks, photo-masks, reticles; Mask blanks or pellicles therefor; Containers specially adapted therefor; Preparation thereof**

**NOTE**

In this main group, at each hierarchical level, in the absence of an indication to the contrary, classification is made in the first appropriate place

**WARNING**

Groups [G03F 1/0007-G03F 1/16](#) are no longer used for the classification of documents as of January 1, 2012. The backfile of these groups is being reclassified into groups [G03F 1/20-G03F 1/92](#) as follows: [G03F 1/0007-G03F 1/0092](#) and [G03F 1/08-G03F 1/16](#) into groups [G03F 1/20-G03F 1/86](#); [G03F 1/02](#) into [G03F 1/88](#); [G03F 1/04](#) into [G03F 1/90](#); [G03F 1/06](#) into [G03F 1/92](#). Until reclassification is complete, groups [G03F 1/0007-G03F 1/16](#) and [G03F 1/20-G03F 1/92](#) should be considered in order to perform a complete search.

- [G03F 1/0007](#) . {using an elastic substrate or involving an optical distortion, e.g. for printing on non flat surfaces}
- [G03F 1/0015](#) . {by drawing, writing, e.g. on a photosensitive surface, or by engraving, e.g. using a stylus; using a typewriter; using chemical copy sheet}
- [G03F 1/0023](#) .. {the masking pattern being obtained by the application of an ink, e.g. by traditional printing, by ink jet printing, by using a typewriter, or by the selective application of a powder, e.g. a toner}
- [G03F 1/003](#) .. {the masking pattern being obtained by thermal means, e.g. by laser ablation( thermal transfer from a ribbon, e.g. [G03F 1/0023](#) )}
- [G03F 1/0038](#) .. {using chemical means, e.g. chemical camera copying}
- [G03F 1/0046](#) . {Phase shift masks}
- [G03F 1/0053](#) .. {Hybrid phase shift masks, i.e. combining plural types of phase-shifting pattern in a single common pattern}

#### **NOTE**

- in this group the term "hybrid" is meant to involve the combination of plural types of phase-shifting pattern in a single common pattern; a mere structural, e.g. geometrical, association of masks with separate patterns is not considered hybrid;  
 - hybrid masks combining a binary pattern with a phase-shifting pattern are only classified in the group corresponding to the phase-shifting aspect, the binary pattern being considered a trivial feature in this context

- [G03F 1/0061](#) .. {Alternating phase shift masks, i.e. Levenson-Shibuya type}
- [G03F 1/0069](#) ... {Auxiliary patterns or specific arrangements of the phase-shifting elements to avoid phase-conflicts, i.e. phase-shifter layout strategies for alternating masks}
- [G03F 1/0076](#) .. {Masks with semi-transparent phase shifters, i.e. attenuated phase-shifting masks}
- [G03F 1/0084](#) .. {Masks where at least part of the patterns comprise no opaque or semi-opaque pattern elements, i.e. phase-edge masks}

- G03F 1/0092 . {Auxiliary processes relating to originals, e.g. repair, washing or inspection}
- G03F 1/02 . by photographic processes for production of originals simulating relief
- G03F 1/04 . by montage processes
- G03F 1/06 . from printing surfaces,{e.g. using a heat or pressure sensitive foil, by pulling an impression, e.g. on a photosensitive sheet}
- G03F 1/08 . Originals having inorganic imaging layers, e.g. chrome masks( [G03F 1/12](#) takes precedence; { X-Ray absorbers [G03F 1/148](#) })
- G03F 1/10 . by exposing and washing out pigmented or coloured organic layers; by colouring macromolecular patterns
- G03F 1/103 . . {the masking pattern being obtained by modification of the polymeric pattern by energetic means, e.g. by carbonisation or by ion implantation}
- G03F 1/106 . . {the masking means, e.g. the dye or pigment being incorporated into the photosensitive material}
- G03F 1/12 . by exposing silver-halide-containing photosensitive materials or diazo-type materials
- G03F 1/14 . Originals characterised by structural details, e.g. supports, cover layers, pellicle rings
- G03F 1/142 . . {Pellicles, pellicle rings or continuous protective layers}
- G03F 1/144 . . {Auxiliary patterns; Corrected patterns, e.g. proximity correction, grey level masks( [G03F 1/0046](#) , [G03F 1/146](#) , [G03F 9/00](#) take precedence )}
- G03F 1/146 . . {Originals for X-Ray exposures, X-Ray masks}
- G03F 1/148 . . . {X-Ray absorbers}
- G03F 1/16 . Originals having apertures, e.g. for corpuscular lithography

### **WARNING**

Groups [G03F 1/20-G03F 1/92](#) are incomplete pending reclassification of documents from groups [G03F 1/0007-G03F 1/16](#). Until reclassification is complete, groups [G03F 1/0007-G03F 1/16](#) and [G03F 1/20-G03F 1/92](#) should be considered in order to perform a complete search.

- G03F 1/20 . Masks or mask blanks for imaging by charged particle beam [CPB] radiation, e.g. by electron beam; Preparation thereof
- G03F 1/22 . Masks or mask blanks for imaging by radiation of 100nm or shorter wavelength, e.g. X-ray masks, extreme ultra-violet [EUV] masks; Preparation thereof
- G03F 1/24 . . Reflection masks; Preparation thereof
- G03F 1/26 . Phase shift masks [PSM]; PSM blanks; Preparation thereof
- G03F 1/28 . . with three or more diverse phases on the same PSM; Preparation thereof
- G03F 1/29 . . Rim PSM or outrigger PSM; Preparation thereof
- G03F 1/30 . . Alternating PSM, e.g. Levenson-Shibuya PSM; Preparation thereof
- G03F 1/32 . . Attenuating PSM [att-PSM], e.g. halftone PSM or PSM having semi-transparent phase shift portion,; Preparation thereof
- G03F 1/34 . . Phase-edge PSM, e.g. chromeless PSM; Preparation thereof
- G03F 1/36 . Masks having proximity correction features; Preparation thereof, e.g. optical proximity correction [OPC] design processes
- G03F 1/38 . Masks having auxiliary features, e.g. special coatings or marks for alignment or testing; Preparation thereof

- G03F 1/40 .. Electrostatic discharge [ESD] related features, e.g. antistatic coatings or a conductive metal layer around the periphery of the mask substrate
- G03F 1/42 .. Alignment or registration features, e.g. alignment marks on the mask substrate
- G03F 1/44 .. Testing or measuring features, e.g. grid patterns, focus monitors, sawtooth scales or notched scales
- G03F 1/46 .. Antireflective coatings
- G03F 1/48 .. Protective coatings
- G03F 1/50 . Mask blanks not covered by [G03F 1/20](#) - [G03F 1/34](#) ; Preparation thereof
- G03F 1/52 . Reflectors
- G03F 1/54 . Absorbers, e.g. of opaque material
- G03F 1/56 .. Organic absorbers, e.g. of photo-resist
- G03F 1/58 .. having two or more different absorber layers, e.g. stacked multilayer absorber
- G03F 1/60 . Substrates
- G03F 1/62 . Pellicles, e.g. pellicle assemblies, e.g. having membrane on support frame; Preparation thereof
- G03F 1/64 .. characterised by the frames, e.g. structure or material, including bonding means therefor
- G03F 1/66 . Containers specially adapted for masks, mask blanks or pellicles; Preparation thereof
- G03F 1/68 . Preparation processes not covered by groups [G03F 1/20](#) - [G03F 1/50](#)
- G03F 1/70 .. Adapting basic layout or design of masks to lithographic process requirement, e.g., second iteration correction of mask patterns for imaging
- G03F 1/72 .. Repair or correction of mask defects
- G03F 1/74 ... by charged particle beam [CPB], e.g. focused ion beam
- G03F 1/76 .. Patterning of masks by imaging
- G03F 1/78 ... by charged particle beam [CPB], e.g. electron beam patterning of masks
- G03F 1/80 .. Etching
- G03F 1/82 .. Auxiliary processes, e.g. cleaning or inspecting
- G03F 1/84 ... Inspecting
- G03F 1/86 .... by charged particle beam [CPB]
- G03F 1/88 . prepared by photographic processes for production of originals simulating relief
- G03F 1/90 . prepared by montage processes
- G03F 1/92 . prepared from printing surfaces
  
- G03F 3/00** **Colour separation; Correction of tonal value**( [photographic copying apparatus in general G03B](#) )
- G03F 3/02 . by retouching
- G03F 3/04 . by photographic means
- G03F 3/06 .. by masking
- G03F 3/10 . Checking the colour or tonal value of separation negatives or positives
- G03F 3/101 .. { Colour or tonal value checking by non-photographic means or by means other than using non-impact printing methods or duplicating or marking methods covered by [B41M 5/00](#) }
- G03F 3/102 .. {Lamination or delamination method or apparatus for colour proofing systems}

G03F 3/103	.. {using tonable photoresist or photopolymerisable systems}
G03F 3/105	.. {using electro photographic materials}
G03F 3/106	.. {using non-macromolecular photopolymerisable compounds having carbon-to-carbon double bonds, other than silicon containing compounds}
G03F 3/107	.. {using silver halide photosensitive materials}
G03F 3/108	.. { using a non-impact printing method, e.g. ink jet, using duplicating or marking methods covered by <a href="#">B41M 5/00</a> , e.g. by ablation or by thermographic means }
<b>G03F 5/00</b>	<b>Screening processes; Screens therefor</b> ( <a href="#">plates or light sensitive layers with incorporated screen G03F 7/004</a> )}
G03F 5/02	. by projection methods( <a href="#">cameras G03B</a> )
G03F 5/04	.. changing the screen effect
G03F 5/06	.. changing the diaphragm effect
G03F 5/08	.. using line screens
G03F 5/10	.. using cross-line screens
G03F 5/12	.. using other screens, e.g. granulated screen
G03F 5/14	. by contact methods
G03F 5/16	.. using grey half-tone screens
G03F 5/18	.. using colour half-tone screens
G03F 5/20	. using screens for gravure printing
G03F 5/22	. combining several screens; Elimination of moirè
G03F 5/24	. by multiple exposure, e.g. combined processes for line photo and screen
<b>G03F 7/00</b>	<b>Photomechanical, e.g. photolithographic, production of textured or patterned surfaces, e.g. printing surfaces; Materials therefor, e.g. comprising photoresists; Apparatus specially adapted therefor</b> ( <a href="#">using photoresist structures for special production processes, see the relevant places, e.g. <a href="#">B44C</a>, <a href="#">H01L</a>, e.g. <a href="#">H01L 21/00</a> , <a href="#">H05K</a></a> )
G03F 7/0002	. {Lithographic processes using patterning methods other than those involving the exposure to radiation, e.g. by stamping}
G03F 7/0005	. {Production of optical devices or components in so far as characterised by the lithographic processes or materials used therefor}
G03F 7/0007	.. {Filters, e.g. additive colour filters; Components for display devices}
G03F 7/001	.. {Phase modulating patterns, e.g. refractive index patterns}
G03F 7/0012	. {Processes making use of the tackiness of the photolithographic materials, e.g. for mounting; Packaging for photolithographic material; Packages obtained by processing photolithographic materials}
G03F 7/0015	. {Production of aperture devices, microporous systems or stamps}
G03F 7/0017	. {for the production of embossing, cutting or similar devices; for the production of casting means}
G03F 7/002	. {using materials containing microcapsules; Preparing or processing such materials, e.g. by pressure; Devices or apparatus specially designed therefor}
G03F 7/0022	.. {Devices or apparatus}
G03F 7/0025	... {characterised by means for coating the developer}

G03F 7/0027	...	{characterised by pressure means}
G03F 7/003	...	{characterised by storage means for the light sensitive material, e.g. cartridges}
G03F 7/0032	...	{characterised by heat providing or glossing means}
G03F 7/0035	.	{Multiple processes, e.g. applying a further resist layer on an already in a previously step, processed pattern or textured surface}
G03F 7/0037	.	{Production of three-dimensional images}
G03F 7/004	.	Photosensitive materials( <a href="#">G03F 7/12</a> , <a href="#">G03F 7/14</a> take precedence )
G03F 7/0041	..	{providing an etching agent upon exposure( <a href="#">G03F 7/075</a> takes precedence; photolytic halogen compounds <a href="#">G03F 7/0295</a> )}
G03F 7/0042	..	{with inorganic or organometallic light-sensitive compounds not otherwise provided for, e.g. inorganic resists( <a href="#">G03F 7/075</a> takes precedence )}
G03F 7/0043	...	{Chalcogenides; Silicon, germanium, arsenic or derivatives thereof; Metals, oxides or alloys thereof( <a href="#">G03F 7/0044</a> takes precedence )}
G03F 7/0044	...	{involving an interaction between the metallic and non-metallic component, e.g. photodope systems}
G03F 7/0045	..	{with organic non-macromolecular light-sensitive compounds not otherwise provided for, e.g. dissolution inhibitors}
G03F 7/0046	..	{with perfluoro compounds, e.g. for dry lithography( <a href="#">G03F 7/0048</a> takes precedence )}
G03F 7/0047	..	{characterised by additives for obtaining a metallic or ceramic pattern, e.g. by firing}
G03F 7/0048	..	{characterised by the solvents or agents facilitating spreading, e.g. tensio-active agents}
G03F 7/008	..	Azides( <a href="#">G03F 7/075</a> takes precedence )
G03F 7/0085	...	{characterised by the non-macromolecular additives}
G03F 7/012	...	Macromolecular azides; Macromolecular additives, e.g. binders{( <a href="#">G03F 7/0085</a> takes precedence )}
G03F 7/0125	....	{characterised by the polymeric binder or the macromolecular additives other than the macromolecular azides}
G03F 7/016	..	Diazonium salts or compounds( <a href="#">G03F 7/075</a> takes precedence )
G03F 7/0163	...	{Non ionic diazonium compounds, e.g. diazosulphonates; Precursors thereof, e.g. triazenes}
G03F 7/0166	...	{characterised by the non-macromolecular additives}
G03F 7/021	...	Macromolecular diazonium compounds; Macromolecular additives, e.g. binders{( <a href="#">G03F 7/0166</a> takes precedence )}
G03F 7/0212	....	{characterised by the polymeric binder or the macromolecular additives other than the diazo resins or the polymeric diazonium compounds}
G03F 7/0215	.....	{Natural gums; Proteins, e.g. gelatins; Macromolecular carbohydrates, e.g. cellulose; Polyvinyl alcohol and derivatives thereof, e.g. polyvinylacetals}
G03F 7/0217	.....	{Polyurethanes; Epoxy resins}
G03F 7/022	..	Quinonediazides( <a href="#">G03F 7/075</a> takes precedence )
G03F 7/0223	...	Iminoquinonediazides; Para-quinonediazides]
G03F 7/0226	...	{characterised by the non-macromolecular additives}
G03F 7/023	...	Macromolecular quinonediazides; Macromolecular additives, e.g. binders{( <a href="#">G03F 7/0226</a> takes precedence )}

G03F 7/0233	....	{characterised by the polymeric binders or the macromolecular additives other than the macromolecular quinonediazides}
G03F 7/0236	.....	{Condensation products of carbonyl compounds and phenolic compounds, e.g. novolak resins}
G03F 7/025	..	Non-macromolecular photopolymerisable compounds having carbon-to-carbon triple bonds, e.g. acetylenic compounds( <a href="#">G03F 7/075 takes precedence</a> )
G03F 7/027	..	Non-macromolecular photopolymerisable compounds having carbon-to-carbon double bonds, e.g. ethylenic compounds( <a href="#">G03F 7/075 takes precedence</a> )
G03F 7/0275	...	{with dithiol or polysulfide compounds}
G03F 7/028	...	with photosensitivity-increasing substances, e.g. photoinitiators
G03F 7/0285	....	{Silver salts, e.g. a latent silver salt image}
G03F 7/029	....	Inorganic compounds; Onium compounds; Organic compounds having hetero atoms other than oxygen, nitrogen or sulfur
G03F 7/0295	.....	{Photolytic halogen compounds}
G03F 7/031	....	Organic compounds not covered by group <a href="#">G03F 7/029</a>
G03F 7/032	...	with binders
G03F 7/0325	....	{the binders being polysaccharides, e.g. cellulose}
G03F 7/033	....	the binders being polymers obtained by reactions only involving carbon-to-carbon unsaturated bonds, e.g. vinyl polymers
G03F 7/035	....	the binders being polyurethanes
G03F 7/037	....	the binders being polyamides or polyimides
G03F 7/038	..	Macromolecular compounds which are rendered insoluble or differentially wettable( <a href="#">G03F 7/075 takes precedence</a> ; macromolecular azides <a href="#">G03F 7/012</a> ; macromolecular diazonium compounds <a href="#">G03F 7/021</a> )
G03F 7/0381	...	{using a combination of a phenolic resin and a polyoxyethylene resin}
G03F 7/0382	...	{the macromolecular compound being present in a chemically amplified negative photoresist composition}
G03F 7/0384	...	{with ethylenic or acetylenic bands in the main chain of the photopolymer}
G03F 7/0385	...	{using epoxydisednovolak resin}
G03F 7/0387	...	{Polyamides or polyimides}
G03F 7/0388	...	{with ethylenic or acetylenic bands in the side chains of the photopolymer}
G03F 7/039	..	Macromolecular compounds which are photodegradable, e.g. positive electron resists( <a href="#">G03F 7/075 takes precedence</a> ; macromolecular quinonediazides <a href="#">G03F 7/023</a> )
G03F 7/0392	...	{the macromolecular compound being present in a chemically amplified positive photoresist composition}
G03F 7/0395	....	{the macromolecular compound having a backbone with alicyclic moieties}
G03F 7/0397	.....	{the alicyclic moiety being in a side chain}
G03F 7/04	..	Chromates( <a href="#">G03F 7/075 takes precedence</a> )
G03F 7/06	..	Silver salts( <a href="#">G03F 7/075 takes precedence</a> )
G03F 7/063	...	{Additives or means to improve the lithographic properties; Processing solutions characterised by such additives; Treatment after development or transfer, e.g. finishing, washing; Correction or deletion fluids}
G03F 7/066	....	{Organic derivatives of bivalent sulfur, e.g. onium derivatives}



- G03F 7/07 . . . used for diffusion transfer([G03F 7/063 takes precedence](#) )}
- G03F 7/075 . . Silicon-containing compounds
  - G03F 7/0751 . . . {used as adhesion-promoting additives or as means to improve adhesion}
  - G03F 7/0752 . . . {in non photosensitive layers or as additives, e.g. for dry lithography}
  - G03F 7/0754 . . . {Non-macromolecular compounds containing silicon-to-silicon bonds(  
[G03F 7/0752 takes precedence](#) )}
  - G03F 7/0755 . . . {Non-macromolecular compounds containing Si-O, Si-C or Si-N bonds(  
[G03F 7/0752 takes precedence](#) )}
  - G03F 7/0757 . . . {Macromolecular compounds containing Si-O, Si-C or Si-N bonds(  
[G03F 7/0752 takes precedence](#) )}
  - G03F 7/0758 . . . . {with silicon- containing groups in the side chains}
- G03F 7/085 . . Photosensitive compositions characterised by adhesion-promoting non-macromolecular additives(  
[G03F 7/075 takes precedence](#) )
- G03F 7/09 . . characterised by structural details, e.g. supports, auxiliary layers(  
[supports for printing plates in general B41N](#) )
- G03F 7/091 . . . {characterised by antireflection means or light filtering or absorbing means, e.g. anti-halation, contrast enhancement}
- G03F 7/092 . . . {characterised by backside coating or layers, by lubricating-slip layers or means, by oxygen barrier layers or by stripping-release layers or means}
- G03F 7/093 . . . {characterised by antistatic means, e.g. for charge depletion}
- G03F 7/094 . . . {Multilayer resist systems, e.g. planarising layers}
- G03F 7/095 . . . having more than one photosensitive layer(  
[G03F 7/075 takes precedence](#) )
- G03F 7/0952 . . . . {comprising silver halide or silver salt based image forming systems, e.g. for camera speed exposure}
- G03F 7/0955 . . . . {one of the photosensitive systems comprising a non-macromolecular photopolymerisable compound having carbon-to-carbon double bonds, e.g. ethylenic compounds}
- G03F 7/0957 . . . . {with sensitive layers on both sides of the substrate}
- G03F 7/105 . . . having substances, e.g. indicators, for forming visible images
- G03F 7/11 . . . having cover layers or intermediate layers, e.g. subbing layers(  
[G03F 7/091 to G03F 7/093 , B41N 3/03 take precedence](#) )}
- G03F 7/115 . . . having supports or layers with means for obtaining a screen effect or for obtaining better contact in vacuum printing
- G03F 7/12 . Production of screen printing forms or similar printing forms, e.g. stencils
- G03F 7/14 . Production of collotype printing forms
- G03F 7/16 . Coating processes; Apparatus therefor(  
[applying coatings to base materials in general B05 ; applying photosensitive compositions to base for photographic purposes G03C 1/74](#) )
- G03F 7/161 . . {using a previously coated surface, e.g. by stamping or by transfer lamination}
- G03F 7/162 . . {Coating on a rotating support, e.g. using a whirler or a spinner}
- G03F 7/164 . . {using electric, electrostatic or magnetic means; powder coating}
- G03F 7/165 . . {Monolayers, e.g. Langmuir-Blodgett}
- G03F 7/167 . . {from the gas phase, by plasma deposition(  
[G03F 7/2035 takes precedence](#) )}
- G03F 7/168 . . {Finishing the coated layer, e.g. drying, baking, soaking}



G03F 7/18	..	Coating curved surfaces
G03F 7/20	.	Exposure; Apparatus therefor( <a href="#">photographic printing apparatus for making copies G03B 27/00</a> )
G03F 7/2002	..	{with visible light or UV light, through an original having an opaque pattern on a transparent support, e.g. film printing, projection printing; by reflection of visible or UV light from an original such as a printed image}
G03F 7/2004	...	{characterised by the use of a particular light source, e.g. fluorescent lamps or deep UV light}
G03F 7/2006	....	{using coherent light; using polarised light}
G03F 7/2008	...	{characterised by the reflectors, diffusers, light or heat filtering means or anti-reflective means used}
G03F 7/201	...	{characterised by an oblique exposure; characterised by the use of plural sources; characterised by the rotation of the optical device; characterised by a relative movement of the optical device, the light source, the sensitive system or the mask}
G03F 7/2012	...	{using liquid photohardening compositions, e.g. for the production of reliefs such as flexographic plates or stamps}
G03F 7/2014	...	{Contact or film exposure of light sensitive plates such as lithographic plates or circuit boards, e.g. in a vacuum frame}
G03F 7/2016	....	{Contact mask being integral part of the photosensitive element and subject to destructive removal during post-exposure processing}
G03F 7/2018	.....	{Masking pattern obtained by selective application of an ink or a toner, e.g. ink jet printing}
G03F 7/202	.....	{Masking pattern being obtained by thermal means, e.g. laser ablation}
G03F 7/2022	..	{Multi-step exposure, e.g. hybrid; backside exposure; blanket exposure, e.g. for image reversal; edge exposure, e.g. for edge bead removal; corrective exposure}
G03F 7/2024	...	{of the already developed image}
G03F 7/2026	...	{for the removal of unwanted material, e.g. image or background correction}
G03F 7/2028	....	{of an edge bead on wafers}
G03F 7/203	...	{comprising an imagewise exposure to electromagnetic radiation or corpuscular radiation}
G03F 7/2032	...	{Simultaneous exposure of the front side and the backside}
G03F 7/2035	..	{simultaneous coating and exposure; using a belt mask, e.g. endless}
G03F 7/2037	..	{Exposure with X-ray radiation or corpuscular radiation, through a mask with a pattern opaque to that radiation}
G03F 7/2039	...	{X-ray radiation}
G03F 7/2041	..	{in the presence of a fluid, e.g. immersion; using fluid cooling means}
G03F 7/2043	...	{with the production of a chemical active agent from a fluid, e.g. an etching agent; with material deposition from the fluid phase, e.g. contamination resists}
G03F 7/2045	..	{using originals with apertures, e.g. stencil exposure masks}
G03F 7/2047	...	{Exposure with radiation other than visible light or UV light, e.g. shadow printing, proximity printing}
G03F 7/2049	..	{using a cantilever}

- G03F 7/2051 .. {Exposure without an original mask, e.g. using a programmed deflection of a point source, by scanning, by drawing with a light beam, using an addressed light or corpuscular source( [G03F 7/70](#) takes precedence )}
- G03F 7/2053 ... {using a laser( [ablative removal B41C](#) )}
- G03F 7/2055 .... {for the production of printing plates; Exposure of liquid photohardening compositions}
- G03F 7/2057 ... {using an addressed light valve, e.g. a liquid crystal device}
- G03F 7/2059 ... {using a scanning corpuscular radiation beam, e.g. an electron beam}
- G03F 7/2061 .... {Electron scattering (proximity) correction or prevention methods}
- G03F 7/2063 .... {for the production of exposure masks or reticles}
- G03F 7/2065 .... {using corpuscular radiation other than electron beams}
- G03F 2007/2067 .. {Apparatus for microlithography}
- G03F 7/213 .. Exposing with the same light pattern different positions of the same surface at the same time{ [G03F 7/70](#) takes precedence }
- G03F 7/22 .. Exposing sequentially with the same light pattern different positions of the same surface{ [G03F 7/70](#) takes precedence }
- G03F 7/24 .. Curved surfaces{ [G03F 7/70](#) takes precedence }
- G03F 7/26 . Processing photosensitive materials; Apparatus therefor( [G03F 7/12](#) to [G03F 7/24](#) take precedence )
- G03F 7/265 .. {Selective reaction with inorganic or organometallic reagents after image-wise exposure, e.g. silylation}
- G03F 7/28 .. for obtaining powder images( [G03F 3/10](#) takes precedence )
- G03F 7/30 .. Imagewise removal using liquid means
- G03F 7/3007 ... {combined with electrical means, e.g. force fields}
- G03F 7/3014 ... {combined with ultrasonic means}
- G03F 7/3021 ... {from a wafer supported on a rotating chuck}
- G03F 7/3028 .... {characterised by means for on-wafer monitoring of the processing}
- G03F 7/3035 ... {from printing plates fixed on a cylinder or on a curved surface; from printing cylinders}
- G03F 7/3042 ... {from printing plates transported horizontally through the processing stations}
- G03F 7/305 .... {characterised by the brushing or rubbing means}
- G03F 7/3057 .... {characterised by the processing units other than the developing unit, e.g. washing units}
- G03F 7/3064 .... {characterised by the transport means or means for confining the different units, e.g. to avoid the overflow}
- G03F 7/3071 .... {Process control means, e.g. for replenishing}
- G03F 7/3078 .... {Processing different kinds of plates, e.g. negative and positive plates, in the same machine}
- G03F 7/3085 ... {from plates or webs transported vertically; from plates suspended or immersed vertically in the processing unit}
- G03F 7/3092 ... {Recovery of material; Waste processing}
- G03F 7/32 ... Liquid compositions therefor, e.g. developers
- G03F 7/322 .... {Aqueous alkaline compositions}

G03F 7/325	....	{Non-aqueous compositions}
G03F 7/327	.....	{Non-aqueous alkaline compositions, e.g. anhydrous quaternary ammonium salts}
G03F 7/34	..	Imagewise removal by selective transfer, e.g. peeling away
G03F 7/343	...	{Lamination or delamination methods or apparatus for photolithographic photosensitive material}
G03F 7/346	...	{using photosensitive materials other than non-macromolecular photopolymerisable compounds having carbon-to-carbon double bonds}
G03F 7/36	..	Imagewise removal not covered by groups <a href="#">G03F 7/30</a> to <a href="#">G03F 7/34</a> , e.g. using gas streams, using plasma
G03F 7/38	..	Treatment before imagewise removal, e.g. prebaking( <a href="#">G03F 7/265</a> takes precedence )}
G03F 7/40	..	Treatment after imagewise removal, e.g. baking
G03F 7/405	...	{Treatment with inorganic or organometallic reagents after imagewise removal}
G03F 7/42	..	Stripping or agents therefor

**NOTE**

Stripping involving the use of a combination of means, e.g. plasma and radiation, is classified in group [G03F 7/42](#) only

G03F 7/421	...	{using biological means only, e.g. enzymes}
G03F 7/422	...	{using liquids only( <a href="#">G03F 7/421</a> takes precedence )}
G03F 7/423	....	{containing mineral acids or salts thereof, containing mineral oxidizing substances, e.g. peroxy compounds}
G03F 7/425	....	{containing mineral alkaline compounds; containing organic basic compounds, e.g. quaternary ammonium compounds; containing heterocyclic basic compounds containing nitrogen}
G03F 7/426	....	{containing organic halogen compounds; containing organic sulfonic acids or salts thereof; containing sulfoxides}
G03F 7/427	...	{using plasma means only}
G03F 7/428	...	{using ultrasonic means only}
G03F 7/70	.	{Exposure apparatus for microlithography}
G03F 7/70008	..	{Production of exposure light, i.e. light sources}
G03F 7/70016	...	{by discharge lamps( discharge lamps per se <a href="#">H01J 61/00</a> )}
G03F 7/70025	...	{by lasers( lasers per se <a href="#">H01S 3/00</a> )}
G03F 7/70033	...	{by plasma EUV sources( plasma EUV sources per se <a href="#">H05G 2/00</a> )}
G03F 7/70041	...	{by pulsed sources}
G03F 7/7005	...	{by multiple sources( <a href="#">addressable array sources specially adapted to produce patterns G03F 7/70391</a> )}}
G03F 7/70058	..	{Mask illumination systems}
G03F 7/70066	...	{Size and form of the illuminated area in the mask plane, e.g. REMA}
G03F 7/70075	...	{Homogenization of illumination intensity in the mask plane, by using an integrator, e.g. fly's eye lenses, facet mirrors, glass rods, by using a diffusive optical element or by beam deflection}

G03F 7/70083	...	{Non-homogeneous intensity distribution in the mask plane}
G03F 7/70091	...	{Illumination settings, i.e. intensity distribution in the pupil plane, angular distribution in the field plane; On-axis or off-axis settings, e.g. annular, dipole, quadrupole; Partial coherence control, i.e. sigma or numerical aperture (NA)}
G03F 7/701	....	{Off-axis setting using an aperture}
G03F 7/70108	....	{Off-axis setting using a light-guiding element}
G03F 7/70116	....	{Off-axis setting using a programmable means, e.g. LCD or DMD}
G03F 7/70125	...	{Use of illumination settings tailored to particular mask patterns( <a href="#">details of setting means G03F 7/70091</a> )}
G03F 7/70133	...	{Measurement of illumination distribution, in pupil plane or field plane}
G03F 7/70141	...	{Illumination system adjustment, alignment during assembly of illumination system( <a href="#">alignment of mask with workpiece G03F 9/70</a> )}
G03F 7/7015	...	{Details of optical elements}
G03F 7/70158	....	{Diffractive optical elements}
G03F 7/70166	....	{Capillary or channel elements, e.g. nested EUV mirrors}
G03F 7/70175	....	{Lamphouse reflector arrangements, i.e. collecting light from solid angle upstream of the light source}
G03F 7/70183	....	{Zoom systems}
G03F 7/70191	...	{Optical correction elements, filters or phase plates for controlling intensity, wavelength, polarization, phase or the like}

**NOTE**

Wavelength or polarisation control is further classified in groups  
[G03F 7/70566](#) , [G03F 7/70575](#)

G03F 7/702	...	{Reflective illumination, i.e. reflective optical elements other than folding mirrors}
G03F 7/70208	...	{Multiple illumination paths, e.g. radiation distribution device, multiplexer, demultiplexer for single or multiple projection systems}
G03F 7/70216	..	{Systems for imaging mask onto workpiece}
G03F 7/70225	...	{Catadioptric systems, i.e. documents describing optical design aspect details}

**NOTE**

Catadioptric systems are further classified in group [G02B 17/0892](#)

G03F 7/70233	...	{Optical aspects of catoptric systems}
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**NOTE**

Further aspects of catoptric systems are classified in group [G02B 17/06](#)

G03F 7/70241	...	{Optical aspects of refractive systems}
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**NOTE**

Further aspects of refractive systems are classified in group [G02B 13/143](#)

<a href="#">G03F 7/7025</a>	...	{Size or form of projection system aperture}
<a href="#">G03F 7/70258</a>	...	{Projection system adjustment, alignment during assembly of projection system( <a href="#">alignment of mask with workpiece G03F 9/70</a> )}
<a href="#">G03F 7/70266</a>	....	{Adaptive optics, e.g. deformable optical elements for wavefront control}
<a href="#">G03F 7/70275</a>	...	{Multiple projection paths, array of projection systems, microlens projection systems, tandem projection systems}
<a href="#">G03F 7/70283</a>	...	{Masks or their effects on the imaging process, e.g. Fourier masks, greyscale masks, holographic masks, phase shift masks, phasemasks, lenticular masks, multiple masks, tilted masks, tandem masks( <a href="#">masks per se G03F 1/14</a> )}
<a href="#">G03F 7/70291</a>	....	{Addressable masks}
<a href="#">G03F 7/703</a>	...	{Non-planar pattern area or non-planar masks}
<a href="#">G03F 7/70308</a>	...	{Optical correction elements, filters and phase plates for manipulating e.g. intensity, wavelength, polarization, phase, image shift( <a href="#">filters per se G02B 5/20</a> )}

#### **NOTE**

Wavelength or polarisation control is further classified in groups [G03F 7/70566](#) , [G03F 7/70575](#)

<a href="#">G03F 7/70316</a>	...	{Details of optical elements, e.g. of Bragg reflectors or diffractive optical elements}
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#### **NOTE**

1. Particular optical materials are further classified in group [G03F 7/70958](#) ; 2. Multilayer reflectors for X-ray or EUV lithography are further classified in group [G21K 1/062](#)

<a href="#">G03F 7/70325</a>	...	{Resolution enhancement techniques not otherwise provided for, e.g. darkfield imaging, interfering beams, spatial frequency multiplication, nearfield lens}
<a href="#">G03F 7/70333</a>	....	{Focus drilling, e.g. FLEX}
<a href="#">G03F 7/70341</a>	...	{Immersion( <a href="#">chemical composition of immersion liquids G03F 7/2041</a> )}
<a href="#">G03F 7/7035</a>	...	{Proximity or contact printer}
<a href="#">G03F 7/70358</a>	...	{Scanning exposure, i.e. relative movement of patterned beam and workpiece during imaging}
<a href="#">G03F 7/70366</a>	....	{Rotary scanning}
<a href="#">G03F 7/70375</a>	..	{Imaging systems not otherwise provided for, e.g. multiphoton lithography; Imaging systems comprising means for converting one type of radiation into another type of radiation, systems comprising mask with photo-cathode}
<a href="#">G03F 7/70383</a>	...	{Direct write, i.e. pattern is written directly without the use of a mask by one or multiple beams( "maskless" lithography using a programmable mask <a href="#">G03F 7/70291</a> )}

G03F 7/70391	....	{Addressable array sources specially adapted to produce patterns, e.g. addressable LED arrays( array sources for exposure apparatus comprising a mask <a href="#">G03F 7/7005</a> ; illumination setting using programmable means in exposure apparatus comprising a mask <a href="#">G03F 7/70116</a> )}
G03F 7/704	....	{Scanned exposure beam, e.g. raster-, rotary- and vector scanning( mask projection exposure involving relative movement of patterned beam and workpiece during imaging <a href="#">G03F 7/70358</a> )}
G03F 7/70408	...	{Interferometric lithography; Holographic lithography; Self-imaging lithography}
G03F 7/70416	...	{Stereolithography, 3D printing, rapid prototyping}

**NOTE**

Apparatus for photolithographical production of three dimensional images are further classified in group [G03F 7/0037](#) and group [B29C 67/0051](#)

G03F 7/70425	..	{Imaging strategies, e.g. for increasing throughput, printing product fields larger than the image field, compensating lithography- or non-lithography errors, e.g. proximity correction, mix-and-match, stitching, double patterning}
G03F 7/70433	...	{Layout for increasing efficiency, for compensating imaging errors, e.g. layout of exposure fields, {; Use of mask features for increasing efficiency, for compensating imaging errors( circuit design per se <a href="#">G06F 17/5068</a> ; designing or making of mask <a href="#">G03F 1/14</a> )}}
G03F 7/70441	....	{Optical proximity correction}
G03F 7/7045	...	{Hybrid exposure, i.e. combining different types of exposure, e.g. projection, proximity, direct write, interferometric, uv, x-ray, particle beam( <a href="#">constructional details G03F 7/70991</a> )}
G03F 7/70458	...	{Mix-and-match, i.e. multiple exposures of the same area using similar types of exposure, e.g. UV exposure}
G03F 7/70466	...	{Multiple exposures, e.g. combination of fine and coarse exposures, double patterning, multiple exposures for printing a single feature, mix-and-match( <a href="#">stitching G03F 7/70475</a> )}
G03F 7/70475	...	{Stitching, i.e. connecting image fields to produce a device field, the field occupied by a device such as a memory chip, processor chip, CCD, flat panel display}
G03F 7/70483	..	{Information management, control, testing, and wafer monitoring, e.g. pattern monitoring( <a href="#">detection arrangements G03F 7/7085</a> )}
G03F 7/70491	...	{Information management and control, including software}
G03F 7/705	....	{Modelling and simulation from physical phenomena up to complete wafer process or whole workflow in wafer fabrication}
G03F 7/70508	....	{Data handling, in all parts of the microlithographic apparatus, e.g. addressable masks}
G03F 7/70516	....	{Calibration of components of the microlithographic apparatus, e.g. light sources, addressable mask, detectors}
G03F 7/70525	....	{Controlling normal operating mode, e.g. matching different apparatus, remote control, prediction of failure}
G03F 7/70533	....	{Controlling abnormal operating mode, e.g. taking account of waiting time, decision to rework, rework flow}
G03F 7/70541	....	{Tagging, i.e. hardware or software tagging of features or components}

G03F 7/7055	...	{Exposure light control, in all parts of the microlithographic apparatus, e.g. pulse length control, light interruption}
G03F 7/70558	....	{Dose control, i.e. achievement of a desired dose( <a href="#">determination of the required dose G03F 7/70625</a> )}
G03F 7/70566	....	{Polarisation control}
G03F 7/70575	....	{Wavelength control, e.g. control of bandwidth, multiple wavelength, selection of wavelength, matching of optical components to wavelength}
G03F 7/70583	....	{Speckle reduction, e.g. coherence control, amplitude/wavefront splitting}
G03F 7/70591	...	{Testing optical components( <a href="#">testing of optical mirrors G01M 11/005</a> ; <a href="#">testing of lenses G01M 11/02</a> ; <a href="#">stray light transmission G03F 7/70941</a> )}
G03F 7/706	....	{Aberration measurement( <a href="#">aberration measurement in general G01M 11/0242</a> )}
G03F 7/70608	...	{Wafer resist monitoring, e.g. measuring thickness, reflectivity, effects of immersion liquid on resist}
G03F 7/70616	...	{Wafer pattern monitoring, i.e. measuring printed patterns or the aerial image at the wafer plane( <a href="#">optical metrology tools per se G01B 11/02</a> and <a href="#">G01B 9/04</a> )}
G03F 7/70625	....	{Pattern dimensions, e.g. line width, profile, sidewall angle, edge roughness}
G03F 7/70633	....	{Overlay( <a href="#">alignment between mask and wafer prior to exposure G03F 9/70</a> )}
G03F 7/70641	....	{Focus( <a href="#">focus measurement prior to exposure G03F 9/7026</a> )}
G03F 7/7065	....	{Defect inspection( <a href="#">defect inspection apparatus per se G06T 7/0004</a> , <a href="#">G01N 21/956</a> )}
G03F 7/70658	....	{Electrical}
G03F 7/70666	....	{using aerial image( <a href="#">aerial image measurement tools for mask inspection G03F 1/0092</a> )}
G03F 7/70675	....	{using latent image}
G03F 7/70683	....	{using process control mark, i.e. specific mark designs}
G03F 7/70691	..	{Handling of masks or wafers}
G03F 7/707	...	{Chucks, e.g. chucking or un-chucking operations( <a href="#">chucks for workpiece processing tools H01L 21/683</a> or <a href="#">H01L 21/687</a> depending on the type of chucking )}
G03F 7/70708	....	{being electrostatic; Electrostatically deformable vacuum chucks( <a href="#">electrostatic chucks for workpiece processing tools H01L 21/6831</a> )}
G03F 7/70716	...	{Stages( <a href="#">stages for workpiece processing tools H01L 21/682</a> )}
G03F 7/70725	....	{control}
G03F 7/70733	...	{Handling masks and workpieces, e.g. exchange of workpiece or mask, transport of workpiece or mask}
G03F 7/70741	....	{Handling masks outside exposure position, e.g. reticle libraries}

**NOTE**

Protective means, e.g. containers, for masks, blanks or pellicles, are further classified in group [G03F 1/66](#)

G03F 7/7075	....	{Handling workpieces outside exposure position, e.g. SMIF box}
G03F 7/70758	...	{Drive means, e.g. actuator, motor( <a href="#">lens or mirror actuators G03F 7/70825</a> )}



G03F 7/70766	...	{Reaction force control means, e.g. countermass}
G03F 7/70775	...	{Position control( interferometers per se <a href="#">G01B 9/02</a> ; encoders per se <a href="#">G01D 5/00</a> ; alignment of mask with workpiece <a href="#">G03F 9/70</a> )}
G03F 7/70783	...	{Stress or warp of chucks, mask or workpiece, e.g. to compensate for imaging error}
G03F 7/70791	...	{Large workpieces, e.g. in the shape of web or polygon}
G03F 7/708	..	{Construction of apparatus, e.g. environment, hygiene aspects or materials}
G03F 7/70808	...	{Construction details, e.g. housing, load-lock, seals, windows for passing light in- and out of apparatus( load-lock chambers for workpiece processors in general <a href="#">H01L 21/67201</a> )}
G03F 7/70816	....	{Bearings( fluid bearings per se <a href="#">F16C 32/06</a> )}
G03F 7/70825	....	{Mounting of individual elements, e.g. mounts, holders or supports( mounts or supports for projection- and illumination system and stages on base-plate or ground <a href="#">G03F 7/70833</a> ; workpiece and mask holders <a href="#">G03F 7/707</a> )}
G03F 7/70833	....	{Mounting of optical systems, e.g. mounting of illumination system, projection system or stage systems on base-plate or ground( mounting of individual elements of said systems <a href="#">G03F 7/70825</a> )}
G03F 7/70841	....	{Constructional issues related to vacuum environment}
G03F 7/7085	...	{Detection arrangement, e.g. detectors of apparatus alignment possibly mounted on wafers, exposure dose, photo-cleaning flux, stray light, thermal load}
G03F 7/70858	...	{Environment aspects, e.g. pressure of beam-path gas, temperature( pollution aspects <a href="#">G03F 7/70916</a> )}
G03F 7/70866	....	{of mask or workpiece}
G03F 7/70875	.....	{Temperature}
G03F 7/70883	....	{of optical system}
G03F 7/70891	.....	{Temperature}
G03F 7/709	....	{Vibration, e.g. vibration detection, compensation, suppression}
G03F 7/70908	...	{Hygiene, e.g. preventing apparatus pollution, mitigating effect of pollution, removing pollutants from apparatus; electromagnetic and electrostatic-charge pollution}
G03F 7/70916	....	{Pollution mitigation, i.e. mitigating effect of contamination or debris, e.g. foil traps}
G03F 7/70925	....	{Cleaning, i.e. actively freeing apparatus from pollutants}
G03F 7/70933	....	{Purge}
G03F 7/70941	....	{Stray fields and charges, e.g. stray light, scattered light, flare, transmission loss}
G03F 7/7095	...	{Materials, e.g. materials for housing, stage or other support having particular properties, e.g. weight, strength, conductivity, thermal expansion coefficient}
G03F 7/70958	....	{Optical materials and coatings, e.g. with particular transmittance, reflectance( details of optical elements <a href="#">G03F 7/70316</a> )}
G03F 7/70966	.....	{Birefringence}
G03F 7/70975	...	{Assembly, maintenance, transport and storage of apparatus}
G03F 7/70983	...	{Optical system protection, e.g. pellicles or removable covers for protection of mask}

G03F 7/70991	...	{Connection with other apparatus, e.g. multiple exposure stations, particular arrangement of exposure apparatus and pre-exposure and/or post-exposure apparatus, shared apparatus, e.g. having shared radiation source, shared mask or workpiece stage, shared base-plate, utilities e.g. cable, pipe or wireless arrangements for data, power, fluids, vacuum( <a href="#">apparatus for processing a workpiece in a plurality of work-stations including at least one lithography chamber H01L 21/67225</a> )}
<b>G03F 9/00</b>		<b>Registration or positioning of originals, masks, frames, photographic sheets or textured or patterned surfaces, e.g. automatically( <a href="#">G03F 7/22</a> takes precedence; preparation of photographic masks <a href="#">G03F 1/00</a> ; within photographic printing apparatus for making copies <a href="#">G03B 27/00</a> )</b>
G03F 2009/005	.	{for microlithography}
G03F 9/70	.	{for microlithography( measuring printed patterns for monitoring overlay <a href="#">G03F 7/70633</a> or focus <a href="#">G03F 7/70641</a> ; projection system adjustment <a href="#">G03F 7/70258</a> ; position control <a href="#">G03F 7/70775</a> )}
G03F 9/7003	..	{Alignment type or strategy, e.g. leveling, global alignment}
G03F 9/7007	...	{Alignment other than original with workpiece}
G03F 9/7011	....	{Pre-exposure scan; original with original holder alignment; Prealignment, i.e. workpiece with workpiece holder}
G03F 9/7015	....	{Reference, i.e. alignment of original or workpiece with respect to a reference not on the original or workpiece}
G03F 9/7019	...	{Calibration}
G03F 9/7023	...	{Aligning or positioning in direction perpendicular to substrate surface}
G03F 9/7026	....	{Focusing}
G03F 9/703	....	{Gap setting, e.g. in proximity printer}
G03F 9/7034	....	{Leveling}
G03F 9/7038	...	{Alignment for proximity or contact printer( <a href="#">proximity or contact printers per se G03F 7/7035</a> )}
G03F 9/7042	...	{Alignment for lithographic apparatus using patterning methods other than those involving the exposure to radiation, e.g. by stamping or imprinting( <a href="#">non-exposure lithographic processes per se G03F 7/0002</a> )}
G03F 9/7046	...	{Strategy, e.g. mark, sensor or wavelength selection}
G03F 9/7049	..	{Technique, e.g. interferometric}
G03F 9/7053	...	{Non-optical, e.g. mechanical, capacitive, using an electron beam, acoustic or thermal waves}
G03F 9/7057	....	{Gas flow, e.g. for focusing, leveling or gap setting}
G03F 9/7061	....	{Scanning probe microscopy, e.g. AFM, scanning tunneling microscopy}
G03F 9/7065	..	{Production of alignment light, e.g. light source, control of coherence, polarization, pulse length, wavelength}
G03F 9/7069	..	{Alignment mark illumination, e.g. darkfield, dual focus}
G03F 9/7073	..	{Alignment marks and their environment( <a href="#">marks specific to masks G03F 1/42</a> ; <a href="#">marks specific to molds or stamps G03F 7/0002</a> ; <a href="#">overlay marks G03F7/20T22</a> ; <a href="#">marks applied to semiconductor devices H01L 23/544</a> )}
G03F 9/7076	...	{Mark details, e.g. phase grating mark, temporary mark}
G03F 9/708	...	{Mark formation}

- G03F 9/7084 . . . {Position of mark on substrate: i.e. position in(x, y, z)of mark, e.g. buried or resist covered mark, mark on rearside, at the substrate edge, in the circuit area, latent image mark, marks in plural levels}
- G03F 9/7088 . . {Alignment mark detection, e.g. TTR, TTL, off-axis detection, array detector, video detection}
- G03F 9/7092 . . {Signal processing}
- G03F 9/7096 . . {Arrangement, mounting, housing, environment, cleaning or maintenance of apparatus}