Ion-beam deposition process for manufacture of binary photomask blanks

Description of Technology: This invention relates to manufacture of binary photomask blanks in photolithography, using the ion-beam deposition technique. These masks can be used with short wavelength (i.e., <400 nanometer) light. Additionally, this invention relates to binary photomask blanks with single or multi-layered coating of chromium, molybdenum, tungsten, or tantalum metal and/or its compounds or combinations thereof, on the blanks.

Patent Listing:

1. **US Patent No.** 5,897,976, Issued on April 27, 1999, "Attenuating embedded phase shift photomask blanks."
http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1&f=G&l=50&co1=AND&d=PTXT&s1=5,897,976.PN.&OS=PN/5,897,976&RS=PN/5,897,976
2. **US Patent No.** 6,174,631, Issued on January 16, 2001, "Attenuating phase shift photomasks."
http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1&f=G&l=50&co1=AND&d=PTXT&s1=6,174,631.PN.&OS=PN/6,174,631&RS=PN/6,174,631
3. **US Patent No.** 6,756,160, Issued on June 29, 2004, "Ion-beam deposition process for manufacture of binary photomask blanks."
http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1&f=G&l=50&co1=AND&d=PTXT&s1=6,756,160&OS=6,756,160&RS=6,756,160
4. **US Patent No.** 6,756,161, Issued on June 29, 2004, "Ion-beam deposition process for manufacture of binary photomask blanks."
http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1&f=G&l=50&co1=AND&d=PTXT&s1=6,756,161&OS=6,756,161&RS=6,756,161

Market Potential: Microlithography is the process of transferring microscopic circuit patterns or images, usually through a photomask, on to a silicon wafer. In the production of integrated circuits for computer microprocessors and memory devices, the image of an electronic circuit is projected, usually with an electromagnetic wave source, through a mask or stencil on to a photosensitive layer or resist applied to the silicon wafer. Generally, the mask is a layer of "chrome" patterned with these circuit features on a transparent quartz substrate. Often referred to as a "binary" mask, a "chrome" mask transmits imaging radiation through the pattern where "chrome" has been removed. The radiation is blocked in regions where the "chrome" layer is present.

While magnetron sputtering is extensively used in the electronics industry for reproducibly depositing different types of coatings, process control in sputtering plasmas is inaccurate because the direction, energy, and flux of the ions incident on the growing film cannot be regulated (ref: The Material Science of Thin Films, Milton Ohring, Academic Press 1992, p. 137). In dual ion beam deposition proposed here as a novel alternative for fabricating masks with simple or complex, single-layered or multi-layered chemistries, independent control of these deposition parameters is possible.

Benefits:

- Independent control of deposition parameters is possible with the proposed dual ion beam.

Applications:

- High-density integrated circuits.

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