

**P-17 Martel Hall**

**SUB-RESOLUTION ASSIST FEATURE TOLERANCES FOR CONTACT WINDOWS USING 193 nm LITHOGRAPHY**

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Combining assist features with appropriate off-axis illumination conditions can significantly improve depth of focus and uniformity of critical dimensions of contact windows. It is known that sub-resolution assist features modify the environment of isolated features in a fashion that they appear dense. In recent years the impact of assist features was mostly studied for gate-level lithography. In this work the placement and dimension control of assist features for contact windows are examined and analyzed using 193 nm lithography in conjunction with state-of-the-art single layer resist. Our study is primarily performed for 160 nm contact windows, and it is based on experimental data obtained from critical dimension measurements with varying focus, exposure dose, and in different environments. Along with optical proximity corrections we use the off-axis illumination technique to increase the depth of focus of contact windows and improve the overall process latitude.

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**ENHANCED MICROLITHOGRAPHY USING COHERENT MULTIPLE IMAGING**

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Coherent multiple imaging is a potential method to enhance both the depth of focus and resolution in optical microlithography. During this process, images of the original mask pattern are generated by a Fabry-Perot etalon located behind the real mask and imaged by the projection lens simultaneously. With this technique, the phase and amplitude conditions strongly determine the final image profile, since the electric fields and not the intensities of the images are added together.

This report describes how coherent multiple imaging can be investigated by means of a commercially available photolithographic simulation software. It was demonstrated that an appropriate pupil plane filter could play the same role as a Fabry-Perot etalon placed between the projection lens and the mask.

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**DETECTION OF CARBON MONOXIDE FROM BIOLOGICAL TISSUE USING DIFFERENCE FREQUENCY GENERATION IN PERIODICALLY-POLED LITHIUM NIOBATE NEAR 4.6 MICRONS**

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Recent work appears to indicate that carbon monoxide (CO) produced by heme oxygenase may also play a role as a physiological messenger similar to nitric oxide.

Since the CO production from biological tissue is extremely small, the appropriate measurement technique of the CO concentration is limited to gas chromatography. Although this method is sensitive, it cannot measure the CO concentration directly, and requires several time consuming intermediate steps of chemical reactions (about 15 min). This work will report the use of a novel sensitive, selective and real-time mid-infrared gas sensor using difference frequency generation (DFG) capable of detecting CO concentrations level at the ppb.m level. A periodically-poled lithium niobate (PPLN) crystal is pumped by a continuous wave Ti: Sapphire laser from 850 to 890 nm [ or equivalent single frequency diode laser ] and a compact diode pumped Nd:YAG laser operating at 1064 nm. The strong IR transition R(6) at 2169.198  $\text{cm}^{-1}$  (4.61 micro-m) was chosen for convenient CO detection without inference from other gas species. Carbon monoxide was collected and flowed into a multipass cell with an effective 18.3 m optical path length. Using such an experimental arrangement , we will detect CO from vascular smooth muscle cells in which heme oxygenase was activated.

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**ASSEMBLY OF METAL-SILICA COMPOSITE NANOPARTICLES AND THEIR INCORPORATION INTO COLLOIDAL ARRAYS**

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Within the last 10 years interests in colloidal chemistry have turned to the development of a unique system called a crystalline colloidal array (CCA). It has become apparent that a CCA is ideal for use in opto-electronic devices, chemical sensors, and for use in enhancing certain spectroscopies. This work is interested in making 2D and 3D CCA's of metal-silica composite nanoparticles. This can be achieved by functionalizing the surface of a gold colloid with an aminosilane molecule and this allows growth of a thin active silica layer approximately 2-4-nanometers in thickness. The silica shell layer can then be varied by further growth using the classic Stober process. This outer silica shell can then be functionalized with a silane-coupling agent and attached to a suitable surface or incorporated into a polymer matrix. The silica shell promotes the formation of the CCA and easily controls the particle spacing with respect to the inner gold colloid. This work will also look at applying this process to metal nanoshells. The optical absorbance and scattering properties of these particles make them interesting candidates for incorporation into arrays.

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**GROWTH OF SILVER NANOSHELLS**

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Metal nanoshells, consisting of a nanoscale dielectric core coated with a thin metallic shell, can be fabricated using molecular self-assembly and colloidal growth chemistry. Metal nanoshells have a plasmon resonance that can be tuned by changing the ratio of the core radius to shell thickness. Previously, we have grown ultra thin gold shells onto silica nanoparticles. This work focuses on the fabrication of silver nanoshells.