Pitch Division by Selective Acid Quenching

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Continue following Moore's Law is becoming increasingly difficult and expensive. The resolution limit of optical exposure tools has reached its limit. Pitch division techniques and double exposure lithography are alternative approaches to patterning with optical exposure tools that enable patterning beyond the theoretical optical resolution limit of the exposure tools. This paper presents a pitch division technique that enables printing of gratings using only a single exposure and is fully compatible with the current manufacturing tools. This technique employs a photoactive system comprising both a photoacid generator (PAG) and a photobase generator (PBG). The PBG is incorporated into the resist in higher molar concentration, but has a base production rate that is slower that the acid production rate of the PAG. The PBG functions as a dose-dependent base quencher, which neutralizes the acid in high dose exposure regions but not in the low dose regions. This photochemical response can be exploited in the design of both positive tone and negative tone resist formulations that provide a developed image of a grating that is twice the frequency of the grating on the mask. We previously reported simulation results that guide optimization of this approach with positive tone polymers and we have presented scanning electron micrographs of images printed in these systems. We now report the design, formulation and characterization of a negative tone resist formulations formulated with both PAG and PBG. Lithography results and work on process optimization will be reported.