I. Deliverable:

Task ID: 425.033

Task Title: Development of an All-Wet Benign Process Based on Catalyzed Hydrogen Peroxide (CHP) Chemical System for Stripping of Implanted State-of-the-Art Deep UV Resists

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Deliverable Title: Report on the preparation and characterization of resist samples dosed with arsenic and other ions at different doping and energy levels

II. Technical Results

Photoresist (PR) samples (thickness ~ 1.5μm) exposed to ion beams were provided by SEMATECH. Sample preparation involved spin coating of UV6 photoresist on silicon wafers that were cleaned in SPM followed by 100:1 HF treatment and then subjected to ozone oxidation. The samples were then implanted with different dosages of arsenic ions (0 to 1E16 As/cm^2) at 20 KeV under 0^0 tilt and 0^0 twist. CHP system containing 5mM Fe^{2+} and 20% H_2O_2 (pH ~2.8) was used to investigate the effect of ion dose on resist removal. Field emission scanning electron microscope (FESEM) and LEEDS Confocal microscope equipped with LEXT OLS software were used to characterize the samples before and after treatment.

Figure 1(A) presents the cross-sectional FESEM images of PR samples implanted with different dosage of As ions. From the images, it is clear that high dose implantation (1E15As/cm^2 and 1E16 As/cm^2) modifies the surface to form a crust layer. Confocal microscopic images of Implanted PR samples treated with CHP solution for 15 minutes in a spinner are shown in figure 1(B). It may be noted that CHP solution creates pores on the surface of PR films and the density of pores decreases with increase in implant dose. Pores are clearly visible even on the crust formed on PR film exposed to 1E16/cm^2 As. As reported earlier, these pores allow access of more conventional cleaning solutions to underlying PR film.

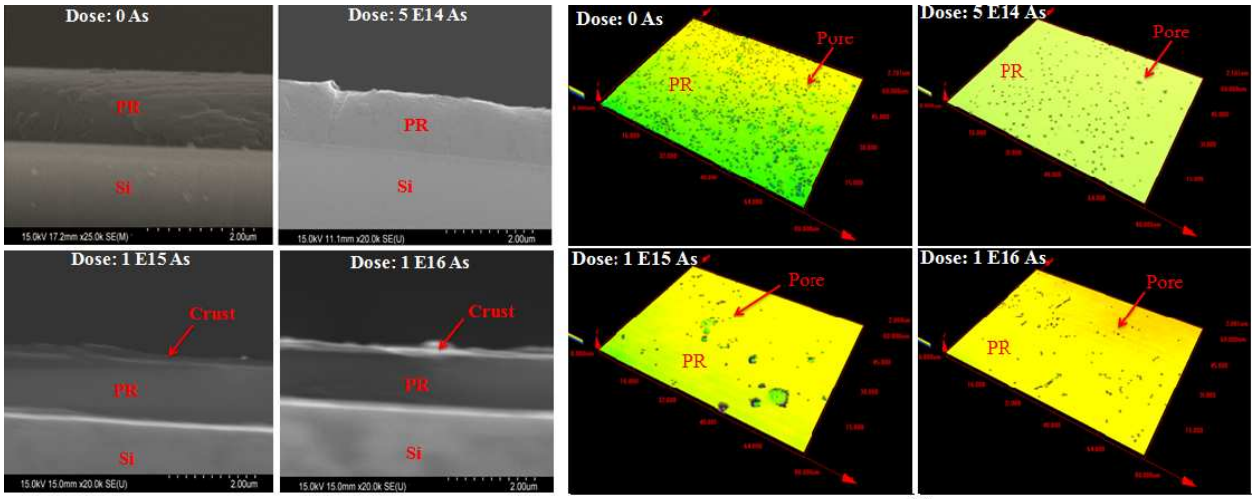

Figure 1(A): Cross-sectional FESEM images of implanted PR samples (dosage :0 to 1E16 As/cm^2) ***1(B)***: 3D Confocal microscopic images of Implanted PR samples after treatment with 20% H_2O_2- 5mM Fe^{2+} CHP solution for 15 minutes

Conclusion:

The ability of CHP systems to locally attack crusts formed on photoresist samples exposed to As ion beams is a function of implant dosage. Attack is evident even on crusts formed at a dose of 1E16/cm^2.