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keV and MeV Ion Beam Modification of Polyimide Films

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Synthetic polymers such as polyimide, polycarbonate, and poly(methyl methacrylate) are long chain molecules which consist of carbon, hydrogen, and heteroatom linked together chemically. Recently, polymer surface can be modified by using a high energy ion beam process. High energy ions are introduced into polymer structure with high velocity and provide a high degree of chemical bonding between molecular chains. In high energy beam process the modified polymers have the highly crosslinked three-dimensionally connected rigid network structure and they showed significant improvements in electrical conductivity, in hardness, and in resistance to wear and chemicals.

Polyimide films (Kapton, types HN) with thickness of 50~100 μm were used for investigations. They were treated with two different surface modification techniques: Plasma Source Ion Implantation (PSII) and conventional Ion Implantation. Polyimide films were implanted with different ion species such as Ar^+, N^+, C^+, He^+, and O^+ with dose from 1 x 10^{15} to 1 x 10^{17} ions/cm^2. Ion energy was varied from 10 keV to 60 keV for PSII experiment. Polyimide samples were also implanted with 1 MeV hydrogen, oxygen, nitrogen ions with a dose of 1x10^{15} ions/cm^2. This work provides the possibility for inducing conductivity in polyimide films by ion beam bombardment in the keloelectronvolt to megaelectronvolt energy range. The electrical properties of implanted polyimide were determined by four-point probe measurement. Depending on ion energy, doses, and ion type, the surface resistivity of the film is reduced by several orders of magnitude. Ion bombarded layers were characterized by Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS), XPS, and SEM.

References

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