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The improvement of Cu metal film adhesion on polymer substrate by the low-power High-frequency ion thruster

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The formation between copper films and poly(ethylene terephthalate) (PET), poly(methyl methacrylate)(PMMA) and Polyimide substrates was treated using ion assisted reaction system and deposited a sequential sputtering by High-Frequency ion source. Low power HF ion thruster with diameter 100mm gives the opportunity to obtain beams of Ar⁺ with currents 20 ~ 150 mA (current density 0.5 ~ 35 mA/cm²) and energy 200 ~ 2500 eV at HF power level 10 ~ 150 W. Especially, inductive sources have become the dominant tool for high aspect-ratio dry etching of sub-micron patterns, and for high density plasma deposition. Using Ar as a working gas it is possible to obtain thrust within 3 ~ 8 mN. Contact angles for untreated films were over 95° and 8° for PET, 10° for PMMA and 12° for PI samples as a condition of ion assisted reaction at the ion dose of 1×10¹⁶ ions/cm², the ion beam potential of 1.2 keV and 4 ml/min for environmental gas flow rate.

90° peel tests yielded values of 15 to 35 for PET, 18 to 40 for PMMA and 12 to 36 g/min for PI, respectively. High resolution X-ray photoelectron spectroscopy in the Cls region for Cu metal on these polymer substrates showed increases in C=O-O groups for PI, whereas PET and PMMA treated samples showed only C=O groups with increase the ion dose. Finally, unstable polymer surface can be changed from hydrophobic to hydrophilic formation such as C-O and C=O that were confirmed by the XPS analysis, conclusionally, the ion assisted reaction is very effective tools to attach reactive ion species to form functional groups on C-C bond chains of PET, PMMA and PI.