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Interfacial adhesion and friction of pyrolytic carbon thin films on silicon substrates

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Frictional behavior and interfacial adhesion of differently textured pyrolytic carbon layers on Si substrate were investigated by indentation and scratch testing. A large amount of elastic recovery and a low coefficient of friction (μ = 0.05 to 0.09) were observed. Elastic/plastic and frictional behaviors of the coatings are strongly influenced by the microstructure of the pyrolytic carbon films, especially by the texture. The critical load at which the first abrupt increase in the normal displacement occurs was used to characterize interfacial adhesive strength. A pyrolytic carbon film deposited at higher residence time from a gas mixture containing 3% oxygen exhibited higher critical loads than film deposited at lower residence time without oxygen. The results can be understood if one assumes that the gas phase composition during deposition significantly influences the bonding strength at the interface. Failure mechanisms are discussed for both types of films.