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Plasma Treatment of Wood Surfaces

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Plasma is being exploited by industry to increase the wettability and adhesion of coatings to plastic automotive components, and to enhance the durability of printing inks on polymers and metals. These commercial applications of plasma treatments encouraged research on the plasma modification wood. The research mainly focused on the use of plasma to improve the adhesion and performance of glues and coatings on wood; plasma coating of wood to increase its hydrophobicity; plasma modification of wood fibres to improve their compatibility with polymers. Our own research on plasma modification began over 20 years ago with a study of the use of plasma treatments to improve the glue bonding of high-density eucalyptus species. We were able to improve the glue bonding of difficult-to-glue eucalyptus species, but improvements appeared to be related to modification of the microstructure of wood rather due to any changes in wetting characteristics of wood. A more recent study also found that modification of the microstructure of wood accounted for improvements in performance of polyurethane coatings on spruce wood. These findings led us to examine the effects of plasma on the microstructure and chemical composition of wood. We observed that the microstructure and chemical composition of wood surfaces is profoundly altered by plasma treatments. Plasma causes differential etching of wood's cellular components, at the surface and also in sub-surface layers. Differential etching of wood's major chemical components, cellulose, hemicelluloses and lignin also occurs. Cellulose is more susceptible to etching than lignin, and, as a result, the lignin-rich layers of wood cell walls are revealed at surfaces subjected to prolonged plasma etching. Plasma etching of wood can be rapid, depending on wood species and treatment parameters, which has opened up the exciting possibility of using plasma to 'machine' wood surfaces and create tailored microstructures with various interesting commercial applications.

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