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Stabilisation of medium pressure plasma polymerised Cyclopropylamine with Hexamethyl Diisocyanate

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Plasma polymerization is a widely used technique to deposit functionalized coatings (so-called plasma polymers) which properties can be tuned by different plasma operational parameters. However, their stability in water and solvents remain a major issue which will be the focus in this work. In the current study, plasma-polymerized cyclopropylamine (CPA) coatings are produced dielectric barrier discharge (DBD) to generate NH_2-rich surfaces and experiments are conducted to evaluate the influence of several operational parameters on the chemical stability of the deposited films. Results have indicated that plasma polymerization at low discharge power and medium pressure with argon resulted in the deposition of coatings containing a high amount of functional NH_2 groups combined with high deposition rates. However, the obtained coatings were found to be highly unstable in water even at the highest possible discharge power due to low cross linking within the coatings. To cope with this problem, plasma coatings were immersed in pure hexamethyldiisocyanate (HDI), after which they were rinsed with hexane to remove excess HDI. By exposing the plasma polymers to HDI, the 2 available -NCO functional groups in HDI will react with $–NH_2$, -COOH and –OH groups present on the coating surface. HDI can either react with 2 surface functional groups thereby acting as a cross-linker which can result in an increase of the coating stability. Another possibility is that only one functional –NCO group reacts with the coating surface to anchor itself to the coating via an amide bond while the other –NCO functional group remains unaffected. To avoid the presence of isocyanate groups on the final coating surface, plasma polymers are placed in water after the reaction with HDI, to convert any unreacted -NCO groups $–NH_2$. Each step of the plasma polymer stabilization process was carefully monitored using AFM, XPS, SEM, WCA and FTIR to monitor changes in thickness, chemical composition and surface morphology. From these investigations, it was found that the proposed stabilization method was able to generate NH_2-rich coatings with high stability in water. Such coatings can have major applications in several research fields such as biomedical devices, tissue engineering scaffolds,…

Keywords
water stability
medium pressure