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Changing the mechanical behaviour of superhydrophobic acrylate plasma coatings: one step towards durable superhydrophobic surfaces

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Superhydrophobicity is a very desirable property for applications such as water-repellent, self-cleaning or low adhesion surfaces. Deposition of a superhydrophobic coating is a practical way to obtain this property since coating deposition is less substrate-dependant than other treatments. In this case, deposition of a coating with strong mechanical resistance is necessary if a good durability of superhydrophobicity is targeted.
It was recently demonstrated that superhydrophobic surfaces can be obtained from the deposition of perfluorodecylacrylate (PFDA) plasma coatings [1] and that particular plasma conditions are responsible for the deposition of a plasma polymer with great function retention of acrylate side chains [2]. The mechanical resistance of these coatings is evaluated here by nanoscratch testing, as already performed in a previous work [3].
Plasma polymers obtained from pure dodecylacrylate (DOCA) exhibit a stiff but fragile behaviour when subjected to scratch loading, whereas the coatings from PFDA show large permanent deformation. Therefore, the admixture of small amounts of DOCA as a reinforcing agent in PFDA coatings is investigated. Furthermore, it is shown that coatings obtained from admixtures lower than 25% (vol) of DOCA in PFDA are still superhydrophobic. Thus, the scratch resistance of plasma polymers obtained from 0%, 10% and 25% DOCA in PFDA is compared. Reduction of permanent deformation of coatings under constant scratch load is observed when admixture of DOCA is increased. However, coating obtained with 25% of DOCA exhibits interfacial spallation at low scratching load. Molecular structure of these plasma polymers can be analysed through recent advances in characterization methods [4] and linked to their mechanical behaviour.
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