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Adhesion of Particulate Materials to Mesostructured Polypyrrole
DARBY HOSS, Purdue University, ROBERT KNEPPER, PETER HOTCHKISS, ALEXANDER TAPPAN, Sandia National Laboratories, BRYAN BOUDOURIS, STEPHEN BEAUDOIN, Purdue University — Interactions based on van der Waals (vdW) forces will influence the performance and reliability of mesostructured polypyrrole swabs used for the collection and detection of trace particles. The vdW adhesion force between materials is described by the Hamaker constant, and these constants are measured via optical and dielectric properties (i.e., according to Lifshitz theory), inverse gas chromatography (IGC), and contact angle measurements. Here, contact angle measurements were performed on films of several common materials and used to estimate Hamaker constants. This, in turn, will allow for the tuning of the design properties associated with the polypyrrole swabs. A comparison of these results to Hamaker constants estimated using Lifshitz Theory and IGC reveals the fundamental behavior of the materials. The Hamaker constants were then used in a new computational vdW adhesion model. The idealized model describes particle adhesion to an array of mesostrucures. This model elucidates the importance of where the particle makes contact with the mesostructure and the independence of vdW forces generated by each mesostructure. These results will facilitate the rational design of polypyrrole swabs optimized for harvesting microscale particles of trace materials.

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