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ABSTRACT

Why do Ag atoms do not condense on perfluorinated materials? – Understanding the mechanismsm for modulation of condensation coefficient for fabrication of nanostructured Ag films

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Selective metal condensation (SMC) was first presented to be possible for Ag and Cu by the Hatton group, by application of perfluorooctyltrichlorosilane (FTS); a highly fluorinated molecule that has very low condensation coefficient (ℂ).[1] The method was then improved by changes in molecular structure and the development of perfluorinated polymethacrylates: PFDMA and PFOMA.[2] Regardless of the great progress made for the application of SMC in the fabrication of nanostructured Ag electrodes, the phenomenon of rejection of Ag atoms from the fluorinated materials was not fully understood.
Here I present a combined XPS, SEM, AFM, and WAXS study in an attempt to shed light on this phenomenon. Two new materials with homologous structures of the side chains were synthesised and characterised. Together with FTS, PFDMA and PVDF-HFP, the two new materials (PFHMA and PFOMA-2F) were used as research devices to determine the key factors that affect the SMC process. Perfluorinated materials were found to be the most effective for the application of SMC due to the low polarisability along the C-F bond, although a weak trend between low surface free energy and low-ℂ was also identified. The design of the side chain was found to be one of the key factors to achieve low-ℂ. Evidence that molecular motion allows for a decrease in ℂ was also reported.

[1] S. Varagnolo and R. A. Hatton, ACS Appl. Energy Mater., 7 (17), 7140-7151. (2024)
[2] P. Bellchambers, C. Henderson, S. Abrahamczyk, S. Choi, J.-K. Lee and R. A. Hatton, Adv. Mater., 35, 13453–13457. (2023)