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Multi-Component Self Assembled Molecular Electronic Thin Films – Towards New High Performance Thermoelectronics

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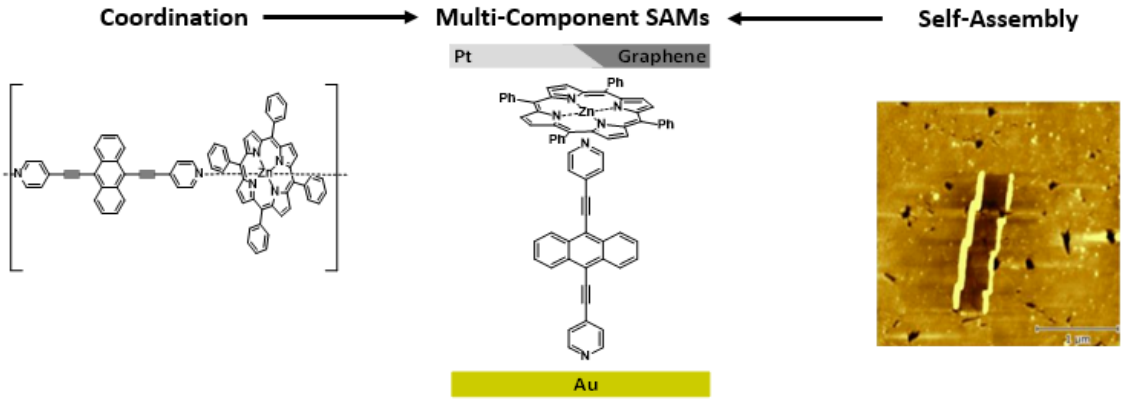
Abstract:

Waste heat is regarded as a low quality form of energy which is difficult to transform and utilise. The development of new techniques to recapture this energy are of high-importance, and organic materials have been widely studied for their thermoelectric properties i.e the conversion of heat into electricity via the Seebeck effect. In particular, self-assembled monolayers (SAMs) present an interesting opportunity within this context as these offer the potential for large-area, flexible, solution processable materials, that have well-defined structures and can take advantage of a number of molecule specific effects, such as tunability and quantum interference (QI).[1] Recently we have demonstrated that constructive QI can be scaled from single-molecules into SAMs, and can be effectively applied to boost both conductance and Seebeck coefficients. However these systems are still limited by their need for rigid-contacts between molecules and metallic-electrodes.[2]

Here we show that these design restrictions can be overcome by assembling multi-layered thin-film materials, by first forming a SAM and then taking advantage of its coordinative behaviour to deposit a second SAM on-top, boosting the Seebeck coefficients of our systems and promoting binding to graphene. These results were quantified through the use of AFM and XPS, and benchmarked against theoretical calculations. Our studies present an interesting avenue towards optimisation of the thermoelectric properties of SAMs via asymmetric interactions with terminal electrodes.[3]

References:



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