MS13-2-17 Engineered growth of polycrystalline amino acid films for eco-friendly piezoelectric sensing #MS13-2-17

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Abstract
In the past ten years, biological piezoelectric materials have emerged as the potential next generation of cost-effective, green electromechanical sensors[1, 2]. The piezoelectric voltages produced under an applied force are inversely proportional to the dielectric constant of the material and so even 'weak' organic piezoelectrics (with modest piezoelectric constants compared to inorganic ceramics[3, 4]), can generate large voltages in response to strain. Amino acids are the simplest biological units, and are inexpensive and easy to crystallise[5-7], and demonstrate measurable piezoelectricity in single crystal[8-10] and polycrystalline forms[11, 12].
Recently we have experimentally validated flexible glycine-based sensors for pipe leak detection and monitoring in real-time, for a variety of flow rates and leak sizes using a custom fluid test rig developed for the validation of PVDF patches[13]. This is the first time that glycine crystals have been grown and characterised as a high-concentration, polycrystalline aggregate for piezoelectric sensing[14]. However a key limitation of this study is that the piezoelectric response of the film was less than that of glycine single crystals due to the random orientation of glycine crystallites[11].
In this work, we will systematically study the effect of crystallisation growth parameters on a number of polycrystalline amino acid films in order to modulate the piezoelectric response and increase the detection sensitivity and voltage output of amino acid-based piezoelectric devices. Further, we will investigate how the use of multi-scale molecular modelling can help us to understand and design the polycrystalline amino acid films and emphasise the potential of computation guided crystal engineering to screen several candidate structures for optimised crystallisation properties that could be utilised for eco-friendly energy harvesting applications.

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