POLYMER FOAMING TO TEMPLATE PEROVSKITE CRYSTALS

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Polymeric foams are the optimal material for several applications, such as thermal and acoustic insulation, energy adsorption and cushioning. Amongst foaming techniques, physical foaming is the most promising one thanks to its low environmental impact. When using this technology, bubble nucleation depends on oversaturation of the polymer gas solution as well as on rate of oversaturation, surfaces chemistry and morphology (heterogeneous nucleation). After the nucleation, the gas diffuses into the bubbles leading to their growth that is hindered by elastic and viscous forces. As for crystals, by choosing opportunely the boundary conditions it is possible to control and study bubbles dynamics. This allows to design foam morphology and thus to produce advanced materials. 2D tailored bubble structures can be used as templates, scaffolds or battery separation.

The study could show the formation of one to multiple layers of bubbles with a confinement foaming setup, which severely reduces the characteristic time of the bubble dynamics. Through an in situ visual analysis we observe the bubble formation during time. Moreover, exploiting the surface influence we can control the bubble nucleation, while choosing the geometry of the setup we can control the growth. Bubbles within a 2D system, in appropriate conditions, are free to form ordered pattern, that we will call air bubble colloidal crystals, or closed structure with small openings, that we will call bunkers.

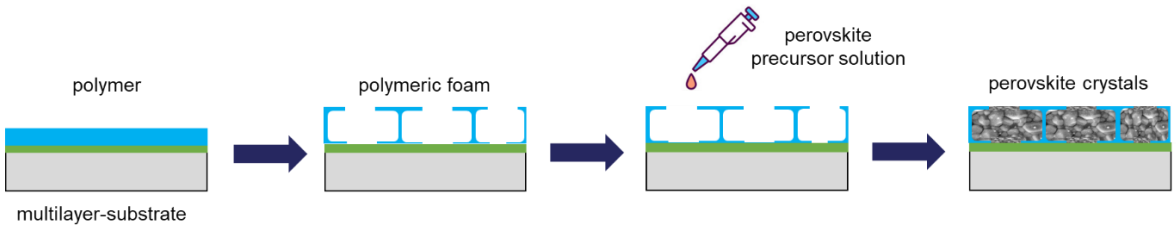

Figure 1: schematical representation of foaming process and perovskite crystals growth using polymeric foamed template

As a possible application of this research a link to perovskite crystals is considered. Perovskite materials have attracted increasing attention over the past years leading to high performance solar cells as well as other optoelectronic applications, such as thin-film transistors, lasers and light emitting diodes. The control over both morphological and electronic properties of the perovskite films is crucial to achieve high-performance perovskite devices. Polymeric foamed template is used to vehicle the crystal nucleation and growth of perovskite crystals. The foamed structure allows to achieve precisely controlled perovskite domains. Moreover, the realization of crystals domains covered by a polymeric shell could improve mechanical and chemical resistance of the devices.

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