Formation of Metal-Organic Framework Glass via Post-Synthetic Modification

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Abstract

As a new family of glasses, hybrid glasses - or metal-organic framework (MOF) glasses - have been discovered very recently [1,2]. Unlike the porous and flexible structures of MOFs, MOF glasses have less porous and more rigid structure, and are expected to have potential applications in some fields, such as drug delivery and nuclear waste capture. It is yet far from the understanding of the mechanism of melting and glass formation in MOF glasses. One important issue is that most MOFs decompose and carbonize upon heating before they melt.

It has been suggested that inducing defects in MOFs, such as post-synthetic modification (PSM), may decrease their melting temperature, and thus enable melting upon heating and subsequent quenching to MOF glasses [3]. In the present work, we report the formation of a MOF glass from a MOF-PSM crystal. Although this PSM-MOF crystal is a composite of two MOFs, as manifested by Rietveld refinements of its power X-ray diffraction pattern, calorimetric results indicate the difference between the PSM-MOF crystal and the physically mixed MOFs. Micrographs of the PSM-MOF crystal and its glass suggest that the new crystal has a core-shell structure. This is also supported by the nitrogen absorption and nano-indentation results. The intra-domain connectivity and short range ordering structure of the PSM-MOF glass are confirmed by the nuclear magnetic resonance spectroscopy and pair distribution function measurements. References

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