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Abstract

Microfluidics enables synthesis of chemicals unachievable through conventional synthetic approaches

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Majority of investigations on crystalline materials, as an appealing category of advanced materials, study their self-assembly process under equilibrium conditions, where only the thermodynamically stable species can be obtained. This limitation not only hampers the proper understanding of the process, but it is a drawback for the effective formation of materials with desired properties. Microfluidic technologies are capable of tackling this limitation through providing superior control over chemical mixing and fluidic conditions as well as offering unique physical phenomena such as laminar flow condition. For instance, a continuous flow microfluidic platform (for example the one illustrated in Fig. 1) can be designed to favor the desired chemical reaction. Such a platform will be capable of obtaining out-of- equilibrium crystal structures, which are not attainable through conventional synthesis approaches currently used for synthesis of materials. Employing this platform, crystalline structures of a coordination polymer that are unachievable through conventional approaches can be achieved. In such a system, altering parameters such as input flow rates, the self-assembly process and reaction conditions can be finetuned, and thus, advanced materials with desired properties, e.g. morphology, can be obtained. Subsequently, controlling the reaction-diffusion area and concentration gradient of the reagents, and hence, the kinetics of the reaction, allows performing controlled synthesis of a spin crossover (SCO) material. These materials possess suitable chemical and physical properties that bring promises for their use in different applications, notably as sensors or molecular switches. While these materials can be synthesized using different methods, only microfluidic-based approach can enable synthesis of these materials at ambient condition with superior control over the properties of the final products with critical switching point near room temperature (unlike other reported similar materials where switching happens at elevated temperature, resulting in limiting their applications). Moreover, preparation of a SCO using a microfluidic platform under controlled synthetic conditions may reveal the interesting unprecedented growing pathways, which cannot be explored using conventional methods. Furthermore, crystalline materials are typically insoluble and unprocessable powders, which pose issues in their handling and application. To overcome this drawback, a microfluidic-based method may be employed to produce processable fibers of crystalline materials. Surprisingly, this approach also allows the controlled deposition and conformal printing of the produced fibers on various surfaces, enabling the application of these materials in advanced patterning technologies. In summary, microfluidic approaches give rise to useful and promising platforms for controlled synthesis, in-depth study, and enhanced processing of materials. These features are not attainable through conventional methods currently used for chemical synthesis.

Biography:
Afshin Abrishamkar, is a Postdoctoral Fellow at PSL Research University, France. He received his Ph.D. in Chemical Engineering from ETH Zurich, Switzerland, in 2018. Prior to his Ph.D., in 2014 he obtained his M.Sc., with distinction, in Chemical and Process Engineering from Lappeenranta University of Technology (LUT), Finland, where he also received the "Excellence in Studies Award" from The Research Foundation of LUT. During his master studies, he moved to ETH Zurich conducting his master's thesis as a visiting student after being awarded of "LUT research fellowship". Prior to that, he received his B.Sc. in Chemical Engineering from Isfahan University of Technology (IUT), Iran in 2011, during which he spent an exchange period working on biodiesel production at CEFET-MG, Brazil.

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