Soft robots unlike their stiff metallic cousins are flexible with their movement not limited by their joints. They are also “squishy” and may undergo deformations to squeeze through little windows or reach objects in confined spaces. Sometimes, they may also self-heal, just like living organisms. Soft robotics may find their use in surgery, prosthetics or exosuits. More futuristic application may reach development of humanoid robots helping people in daily tasks.

To work, soft robots need to be built from soft electronics that would be mechanically like human tissue. Materials may be composed of hydrogels, conductive polymers or composite materials, where non-conductive “plastic” is mixed with conductive solid components. Within the latter, however, the solid component increases rigidity and hardness of the material. Recently, liquid metals, such as eutectic gallium indium (EGaIn) have gained popularity as a conductive filler, because of its flowability and deformability. Gallium-based liquid metals look just like mercury, except they are non-toxic. When used in materials, they can form stretchable electronics (**Figure 1A**) and wearables that conform to irregular geometric shapes. Typically, liquid metal-based composites are prepared by simple mechanical blending with liquid rubber, such as polyurethane or silicon, followed by its curing. Liquid metal forms micro or nanosized droplets surrounded by native non-conductive gallium oxide shells. Initially these materials are non-conductive, even though the amount of the liquid metal is often higher than 50 vol. %. To become conductive, they need to be activated mechanically (by pressing) or by heating (conventionally or by using light or microwave irradiation) (**Figure 1B**). High metallic content makes them expensive and not sustainable. Liquid metals can be also printed on a material to form conductive tracks, but they may leach over time and the tracks may become less conductive. Thus, high control over morphology of conductive liquid metal networks is desired. Microphase separation that leads to well defined morphologies occurs in amphiphilic block copolymer blends (**Figure 2**). These copolymers are composed of two segments of vastly different polarities. When not connected these segments would not mix, but as they are connected, they phase separate into well-defined morphologies, which can be used to direct localization of added conductive fillers, such as liquid metals. Because of deformability of liquid metals, a wide range of nanostructured morphologies is expected. Many of them may be exploited depending on the application, e.g. in stretchable, soft conductors, wearable sensors as well as bioelectrodes or artificial muscles.

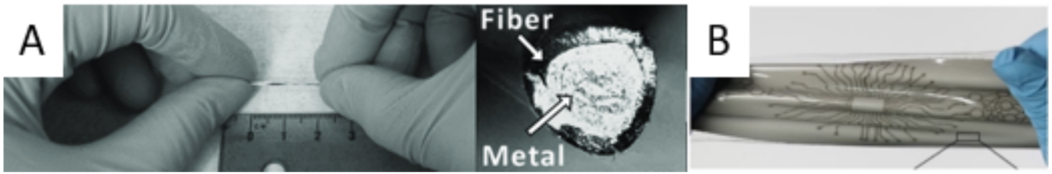

Figure 1. (A) Stretchable conductive fiber filled with EGaIn and its cross-section[1], (B) stretching elastomeric LM composite with electrically conductive tracks obtained using a 2D plotter [2].

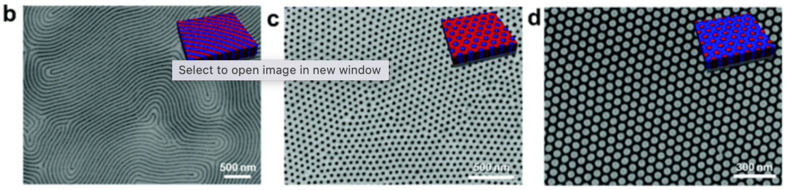

Figure 2. Bimodal phase separated block copolymer nanostructures imaged by SEM together with their colored model; PMMA (blue), PS (red)[3].

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