2D transition metal dichalcogenide-conductive polymer hydrogels for flexible energy storage devices

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Wearable technologies will be the next frontier for device applications: they have been used for years, but the next step in this field would be to exploit these devices to both store and fuel the different individual daily necessities.[1] In order to do so, flexible and not-dangerous materials, that can achieve the highest performance possible without being degraded by daily usage and unusual deformation, are needed. For this reason, gels and, more specifically, conductive polymer hydrogels (CHPs)[2] are a very interesting class of material that allows to bridge the gap between electronics and the flexibility necessary to be used in wearable devices, while featuring good biocompatibility. Here, we report on the synthesis of hybrid CHPs based polyaniline (PANI) and 2D transition metal dichalcogenides (TMDCs), employing different methodologies and formulations. In particular, we resort to liquid phase exfoliation (LPE)[3] to produce 2D TMDCs in both the 2H and 1T phase and to *in-situ* polymerization to produce PANI chains directly on the surface of these nanomaterials. Further morphology tuning is achieved by employing templating agents, being some of them also suitable to induce gelation. The as-obtained hydrogels are characterized through a combination of techniques and their swelling behaviour and mechanical properties are investigated. Finally, they are integrated into proof-of-concept energy storage devices, to understand their potential for future use within flexible and wearable technologies.

References

[1] Sumboja et al., Chem. Soc. Rev., **2018**, *47*, 5919-5945
[2] Li Le et al., Chem. Commun., **2022**, *58*, 185-207
[3] Pinilla, S., Coelho, J., Li, K. et al., Nat Rev Mater, **2022**

Figures

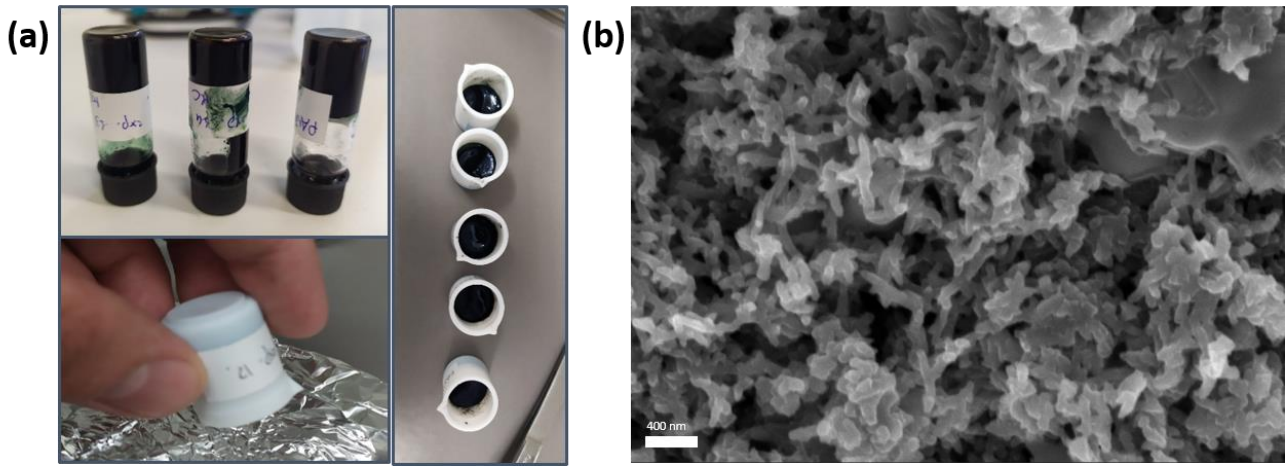

Figure 1: (a) 1T-MoS_2@PANI hydrogels, (b) SEM image of 1T-MoS_2@PANI aerogels