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# Selectivity and functionality on graphene

Graphene is well known as archetype of the 2-D materials, widely recognized for a broad range of applications, including (opto)-electronics due to its outstanding ambipolar charge carrier mobilities and high transparency. These factors together with the highly ordered 2-D structure, makes graphene an ideal substrate for the growth of layered structures, enabling the assembly of heterostructures with graphene as the key step for the realization of complex hybrid device architectures. Although this potential is well known, very often some of these properties need to be tuned. Functionalization of graphene can help in both tuning its properties and providing extra tools making it even more versatile. The functionalization has to overcome three challenges: Reaction, Characterization, Use. While the reactivity of graphene is nowadays quite understood, the characterization is complicated by the intrinsic monolayer character of the material. The most important aspect is the extended functionality of the material that can be made of a certain functionalization. In our research we were investigating the formation of graphene heterostructures in a selective fashion and we wanted to explore their potential for (opto)-electronic applications. In this topic, we achieved highly selective growth of PEDOT on patterned graphene, providing unique hole-conducting/electron-blocking heterostructures. Following this trend, we developed a highly efficient process of selective and oriented growth of various 2-D crystalline materials (optically active) on monolayer graphene. By varying the organic precursors for the active material which is composed of alternated organic and inorganic layers, different interactions leading to selective perovskite self-assembly on graphene were achieved. Varying the length of the aliphatic chain or size of the aromatic moiety (present in the organic part) affects the selectivity of film formation on graphene due to the hydrophobic interactions and/or π–π stacking, respectively. Using the self-assembly principle, high spatial resolution and uniform coverage was achieved in the range from 5 μm up to centimeter scale.

## References

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