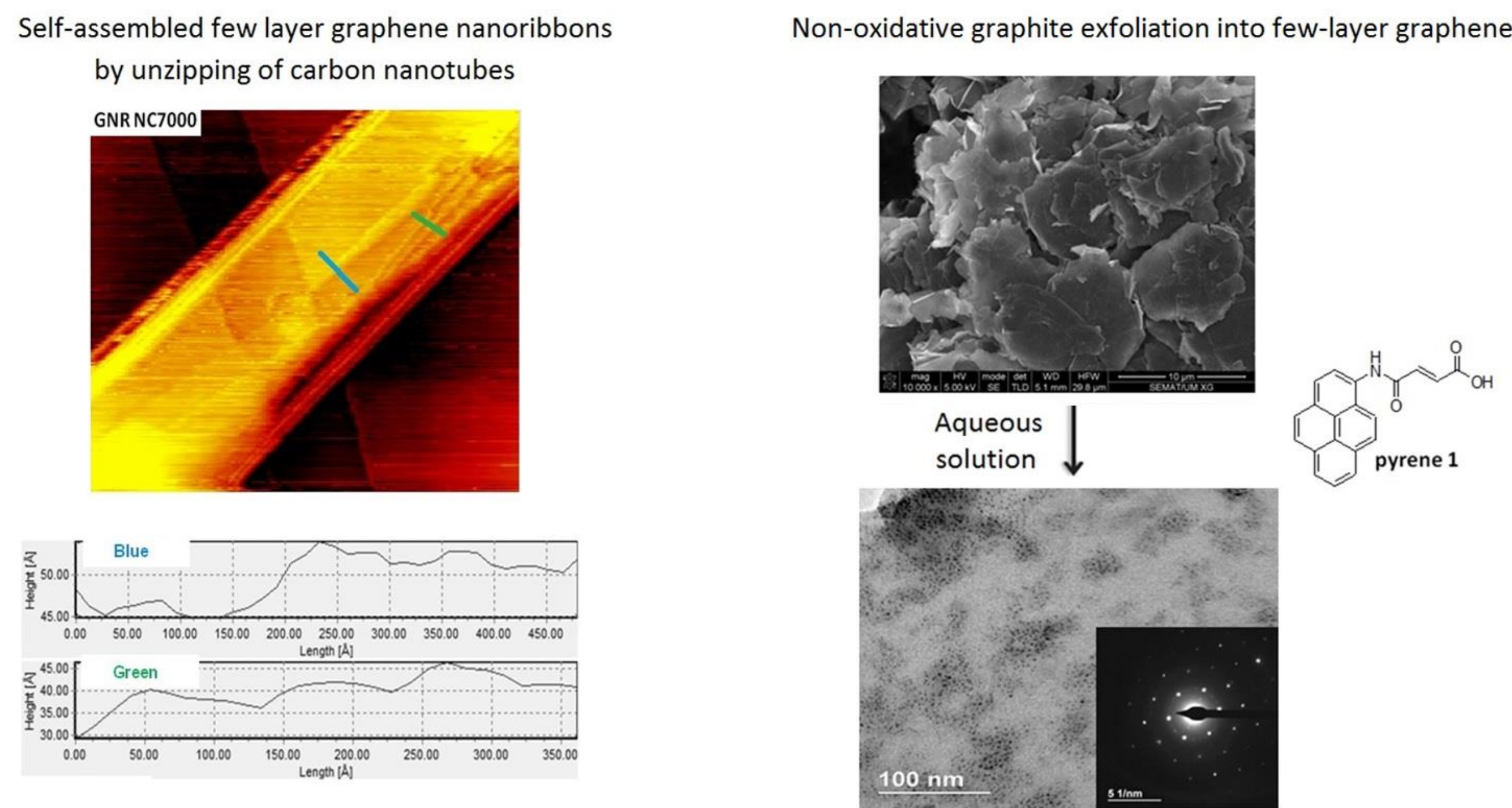


Preparation of graphene nanoribbons and few-layer graphene in solution



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Objectives

The work summarizes two approaches developed at IPC to produce suspensions of graphene through non-oxidative routes.

One of the approaches is based on the unzipping of functionalized carbon nanotubes (CNT) in ethanol solution to form graphene nanoribbons (GNR).

The other approach concerns the exfoliation of graphite in water through non-covalent functionalization to produce few-layer graphene. The surfactant was a pyrene derivative synthesized at IPC, containing a polar group attached.

Methods and techniques

The GNR were formed by unzipping of functionalized CNT [1,2] in ethanol using ultrasounds. [3] The solutions were centrifuged and the remaining GNR suspension was deposited on HOPG surfaces and analysed by scanning tunnelling microscopy (STM), and deposited on glass for Raman spectroscopy.

The graphite was exfoliated in aqueous solutions of modified pyrene (pyrene 1), [4] observed by TEM and characterized by Raman spectroscopy

Results

Fig. 1 a) illustrates the formation of functionalized graphene by unzipping of the outer layer of functionalized CNT. The CNT observed by STM (Fig. 1 b) and functionalized could unzip the outer layer (Fig. 1 c) producing GNR as imaged in Fig. 1 d). These GNR tended to stack into few layers, with an interlayer spacing larger than that of graphite, as shown by the linear profile below Fig. 1d). This larger distance is consistent with the distance required to accommodate the functional groups bonded. Raman spectroscopy demonstrated the formation of few-layer graphene stacks.

Fig. 2 shows an SEM image of the graphene platelets that were subject to exfoliations in aqueous solution of modified pyrene (pyrene 1). The TEM image illustrates the exfoliated graphite, and Raman spectroscopy detected the formation of few-layer graphene.

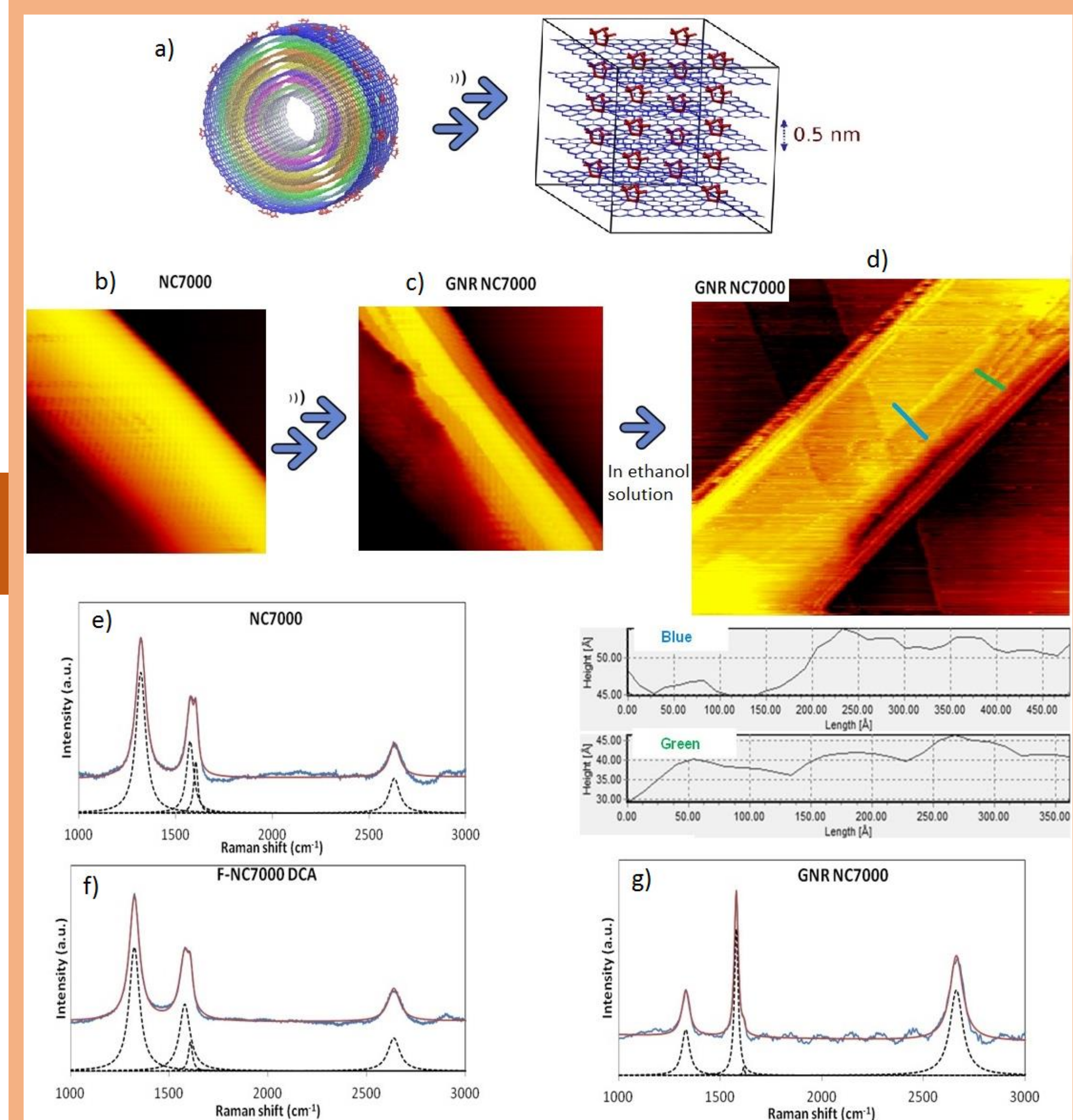


Figure 1

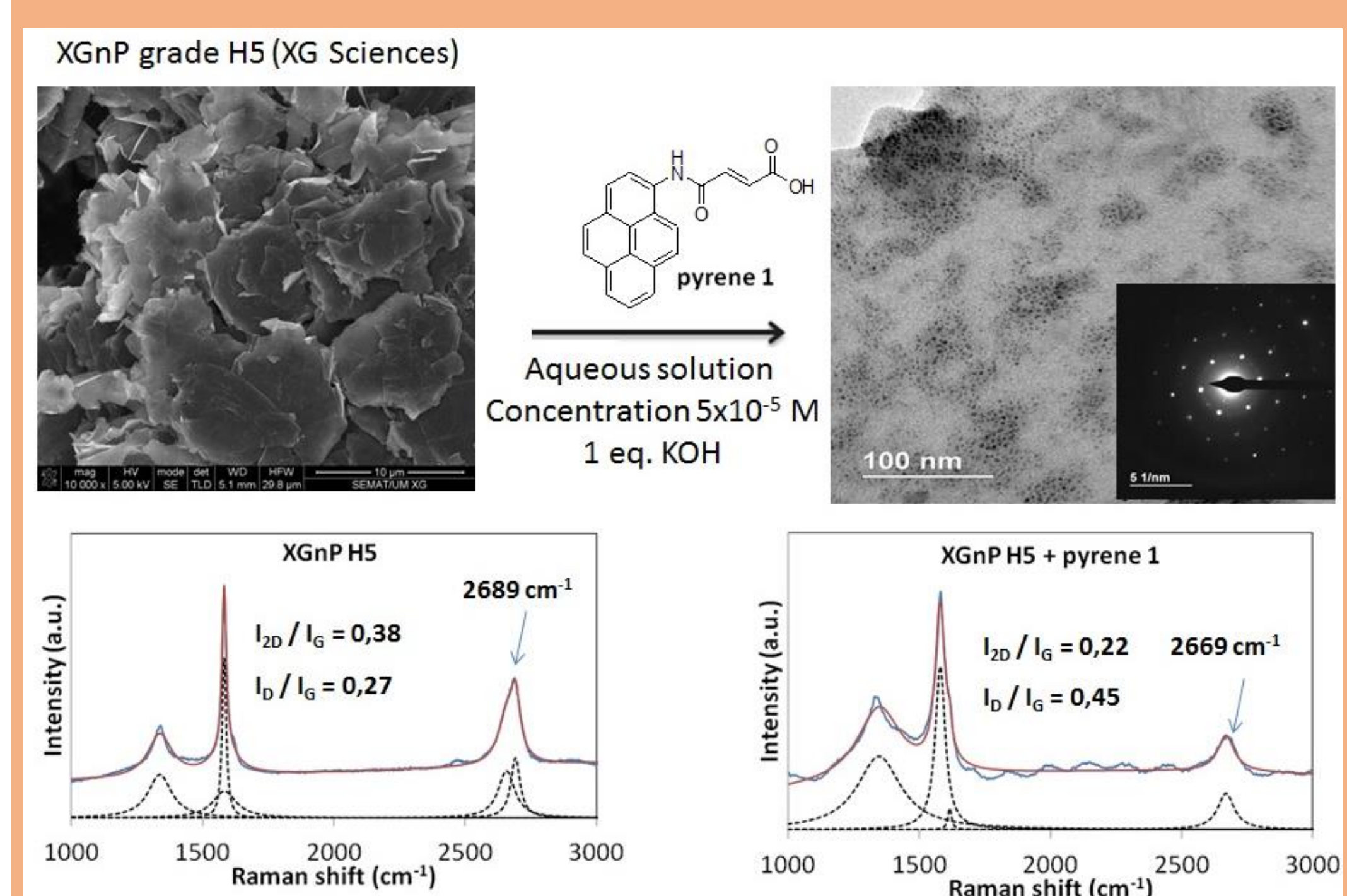


Figure 2

Publications

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Acknowledgements: The authors are thankful to Prof. Robert Young, from the School of Materials, University of Manchester, UK, and Prof. Liv Horneaker, from iNANO at Aarhus University, DK, for the collaboration on the Raman and STM analysis, respectively.

