Raman imaging and chemisorption studies of methylene blue dyeing of antimicrobial textile fibres

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Since its discovery, surface enhanced Raman scattering (SERS) spectroscopy has been used to detect organic molecules adsorbed at metallic nanoparticles (NPs), typically Au and Ag.[1,2] Numerous works have reported the development of efficient SERS substrates to detect analytes in multiple domains.[1,2]
On the other hand, in the past decade, the textile industry has applied new techniques for the deposition of nano-sized particles on textile fibres in order to enhance properties of conventional fabrics.[3,4] Moreover, the new functionalities arising from the incorporation of metal nanoparticles (NPs) on textile fibres make them good candidates in domains such as wound dressing, smart textiles, water treatment, biosensors and paper industry. Additionally, textile fibres containing Ag nanoparticles have been widely explored for a number of antimicrobial fabrics.[3,4]
This research shows that Raman and SERS mapping can be used with advantage in the monitoring of textile dyeing process, which is a critical stage in the manufacture process of fabrics.[5] Using Ag containing linen fibres stained with methylene blue (MB), it was possible to map the local distribution of the MB dye in the fibres by Raman imaging. MB was selected as the molecular probe not only as a model dye but also because it occurs in aqueous solution in the form of dimer or monomer species each having different characteristic optical absorption, hence resulting in hue variations. Our results demonstrate that by using Raman imaging, it is possible to distinguish the preferred adsorbate form on distinct types of nanocomposite fibres and their local distribution. This investigation allows to foreseeing the use of this technique in terms of quality control of antimicrobial Ag containing fabrics, which is a market in great expansion.

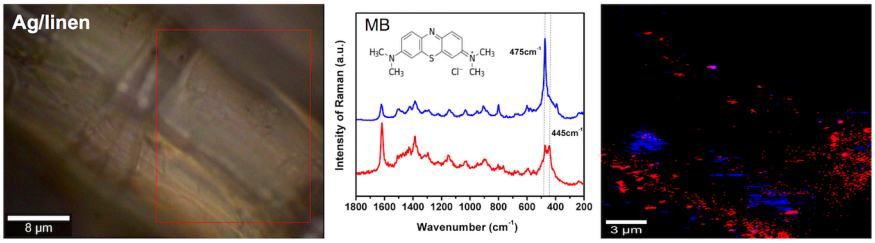

Figure 1: Optical photograph (right) and combined Raman image (left) using two different Raman spectra of MB (10^{-4}M) adsorbed on Ag/linen composite; chemical structure of MB and Raman spectra of MB species used for the combined Raman image (633 nm excitation laser source) (middle);

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