Controlling photothermal properties in cellular niche – synthesis and functionalization of novel molybdenum oxide nanocolloids

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Application of nanomaterials in living organisms imposes requirements on their stability in biological media, non-toxicity, and preserved activity. For photothermal nanomaterials, this translates to constant optical properties and high photothermal conversion in target cells. As for their low toxicity [1], optical tunability [2] and structural flexibility [3], molybdenum-oxides gained significant attention in the development of photothermal nanoplatforms [1, 4]. In our previous work, we prepared photothermal MoO_X nanocolloids by liquid-phase exfoliation (sonication) and observed their internalization by confocal Raman microscopy [5]. Recently, we proved that microwave-assisted synthesis of molybdenum oxides provides control not only over particle size, but also their oxidation state [6]. In this contribution, we explore in detail the link between parameters of the synthesis, photothermal properties of products, and cell interactions in relation to surface functionalization. In addition to physico-chemical characterization (TEM, UV-vis, pH-stability, XPS, photothermal conversion efficiency), biological tests for toxicity and photothermal activity of prepared products *in vitro* were performed. Complementing performance comparison of different microwave products and its explanation from structural point of view, obtained results bring focus to delicate interplay between coating and photothermal performance in cells. Whereas fully protected MoO_X nanocolloids with constant optical properties provide stable photothermal response, MoO_X nanocolloids without such conservative functionalization exhibit pH-dependent change in absorbance. In our case, it led to decreased efficiency, but in future it can provide a potent mechanism to selectively restrict photothermal activity to specific characteristics of cancer tissue.
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