Few-layered and multi-layered MoS_2 produced by hydrothermal route under influence of different reaction times and Mo:S ratios

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Few-layered and multi-layered MoS_2 fabricated by top-down and bottom-up routes have been recently explored for dye [1] and metal adsorption [2]. Here, we explore the synthesis and characterization of MoS_2 obtained by a hydrothermal route and investigate the influence of reaction time and Mo:S precursors ratios. Our results demonstrate differences between few layers (supernatant) and multi-layered (precipitate) MoS_2 obtained by a centrifugation step (10 min/8000 rpm/5 °C). Raman analysis shows the characteristic peaks of MoS_2 at 380 cm^{-1} (E_{2g}) and 404 cm^{-1} (A_{1g}), without the appearance of longitudinal acoustic mode peaks. We observed that by increasing the reaction time from 7 hours to 17 hours the photoluminescence intensity of MoS_2 few-layered upon excitation at 330 nm also increases. The systematic analysis of XPS allowed us to verify that the reaction time augment leads to a shift in the position of characteristics Molybdenum (Mo3d) 3/2 and 5/2 peaks, both to lower energies and indicating an increment of 1T phase content [3,4]. Additionally, through XPS results we observed the presence of well-defined splitting in the signal of Sulphur (S2p) in few-layered and multi-layered MoS_2 that can be associated with edge contribution [5] and surface plasmons [6], with a higher contribution presented in the few-layered product than in the multi-layered products. The optimization of hydrothermal parameters – *e.g.* temperature and Mo:S ratio – can be a suitable strategy to help tailoring the MoS_2 properties such as PL, 1T/2H phase and edge contribution, which in turn can enhance the material's performance for application in environmental remediation or other applications.

References

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Figures

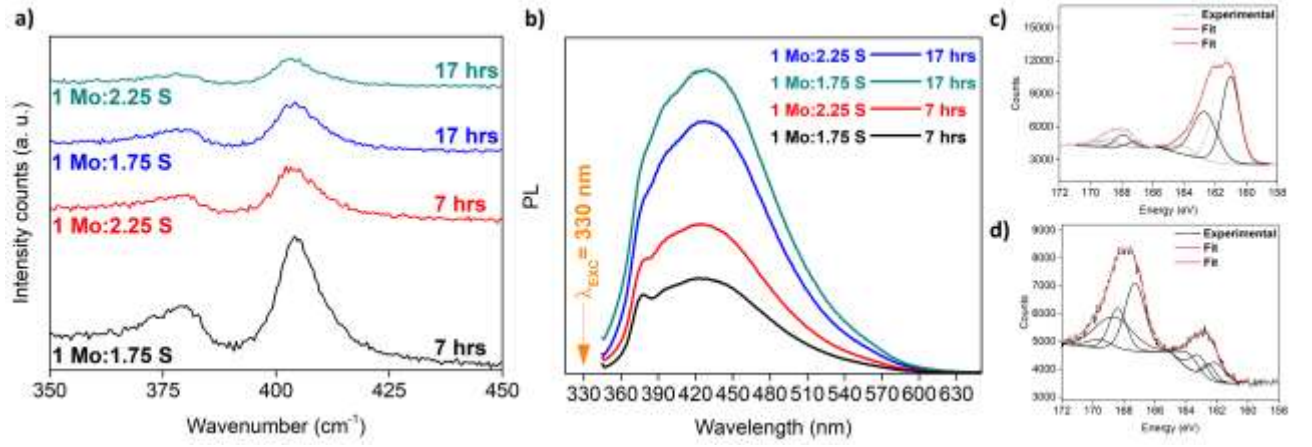

Figure 1: Physical chemical characterizations of MoS_2 synthesized by hydrothermal route at different Mo:S ratios and temperature a) Raman of multi-layered MoS_2, b) Photoluminescence spectra of few-layered MoS_2 and XPS spectra for c) multi-layered and d) few-layered MoS_2.