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Phyllosilicates: an emerging class of naturally abundant layered materials

Raphaela de Oliveira[1,2], Alisson R. Cadore[3], Angelo Malachias[1], Klaus Krambrock[1], Ingrid D. Barcelos[2]

[1]*Physics Department, Federal University of Minas Gerais (UFMG), Belo Horizonte 30123-970, Minas Gerais, Brazil.*

[2]*Brazilian Synchrotron Light Laboratory (LNLS), Brazilian Center for Research in Energy and Materials (CNPEM), Campinas 13083-100, São Paulo, Brazil.*

[3]*School of Engineering, Mackenzie Presbyterian University, São Paulo 01302-907, São Paulo, Brazil.*

raphaeladeog@ufmg.br

Abstract

Beyond graphene, most of the attempts in finding interesting layered materials (LMs) that are capable of being reduced to mono and few-layers have been made in synthesized materials such as hexagonal boron nitride and transition metal dichalcogenides. In an effort to increase the list of naturally occurring LMs that are abundant in nature and could become an alternative low-cost source of two dimensional (2D) materials over its synthetic counterparts, recent research has been carried out in the group of phyllosilicate minerals which are wide band gap insulators that can be mechanically exfoliated to monolayers [1].
We present here this emerging class of naturally abundant LMs, which include talc and muscovite mica as the most studied materials. We also performed a systematic characterization of two barely explored phyllosilicate specimens – clinochlore and phlogopite - by several experimental techniques followed by a theoretical study by first-principles calculations. We provide a complete description of their 2D structures and fundamental properties from their bulk 3D form. Our results identify that the impurities present in the samples play a fundamental role in determining their macroscopic properties and demonstrate that ultrathin layers with atomically flat surface can be obtained for both materials [2,3].
Specifically, we shown that clinochlore maintain its vibrational assignment and insulating properties when reduced to a few layers [2] and, exploring phlogopite in van der Waals heterostructures, we demonstrated an enhancement on the 1L-WS2/phlogopite optical quality similarly to that obtained on 1L-WS2/hexagonal boron nitride heterostructures [3].

References

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[3] A. R. Cadore *et al*, 2D Mater. 9, 035007 (2022).

Figures

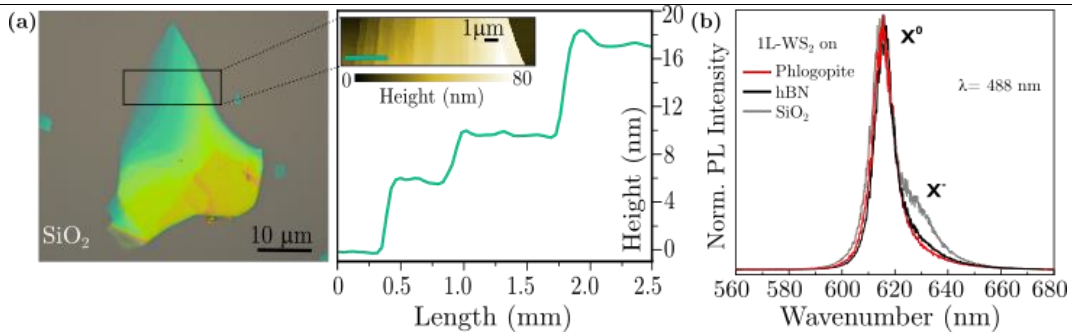

Figure 1: a) Ultrathin layers of clinochlore with atomically flat surface. b) Enhancement on the 1L-WS2/ phlogopite optical quality.