Thermally induced strain and doping of monolayer MoS2 on metal, insulator and WBG substrates

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Electronic devices based on 2D materials are an emerging research topic both for applicative and basic aspects. In this field the transition metal dichalcogenides are of particular interest due to their semiconducting properties. In particular, MoS2 is attracting interest because in the monolayer (1L) form it has a direct energy band gap that, associated to the semiconductor character, offers opportunities also for photonic devices. One of the criticalities in this material is related to the production and the possibility to be grown on different substrates in view of applications.

In the present work 1L MoS2 has been grown by chemical vapor deposition or has been mechanically exfoliated on metal (Au), insulator (SiO2, Al2O3) and semiconductor (GaN) substrates. A deep characterization is reported by MicroRaman e Microphotoluminescence to evalute the doping and strain of the obtained systems as well as the emitting features related to the exciton recombination in the 1.9 eV range. It is observed that the substrate affects the level of doping and the emission efficiency.

The vulnerability of the 1L MoS2 has been tested by thermal treatments in controlled atmosphere of O2 or Ar and it has been found that independently on the physical properties of the substrate it is possible to tune the content of charge carriers of 1L MoS2 and the exciton recombination process.

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