Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Effects of the dielectric environment on the electron transport properties of single-layer MoS_2 SIMONE BERTOLAZZI, ADRIEN ALLAIN, DOMINIK LEMBKE, ANDRAS KIS, EPFL — Two-dimensional materials, such as graphene, boron nitride and transition metal dichalcogenides, offer a wide range of electronic, optical and mechanical properties that can be advantageous for several applications in nanotechnology. Among these materials, single-layer molybdenum disulfide (MoS_2) shows great potential for scaling field-effect transistor devices, due to an optimal electrostatic control of the 2D semiconducting sheet, large energy bandgap and minimal leakage currents. However, to fully exploit the potential of this atomically thin semiconductor, additional experimental efforts need to be undertaken to boost the device performance and access the theoretical intrinsic electron mobilities. To pursue this objective, it is mandatory to reduce the density of charged impurities, both in the semiconducting sheet and in its surrounding environment, and to limit carrier scattering induced by polar optical phonons in the dielectric surface. Here we present the results of our recent experimental investigation of the electron transport properties of single-layer MoS_2 mechanically exfoliated/transferred onto different substrates, with varying surface chemistry, surface roughness and dielectric permittivity. We will show temperature-dependent four-terminal measurements of the electrical conductivity of single-layer MoS_2 in contact with various insulating materials, including 2D sheets of hexagonal boron nitride, organic polymers and metal oxides.

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Date submitted: 14 Nov 2013 Electronic form version 1.4