Two-dimensional materials "talking" to their environment

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Every atom in two-dimensional materials such as graphene or transitional metal dichalogenides (TMDCs) belongs to the surface. Because of that, 2D materials are strongly affected by their microenvironment. That interplay is interesting in itself and can be used to build functional devices. In this talk, we show that excitations in 2D materials function as exquisite probes of the physical and chemical properties of the microenvironment of these materials.

First, we explore graphene field effect transistors submerged inside liquids. We than explore the complex interplay between electrical transport in graphene and the electrical double layer in the liquid. Next, we examine screening of excitons in TMDCs by the dielectric environment of these materials. Finally, we study near-field energy transfer between TMDCs and nanoscale quantum emitters (semiconductor quantum dots or dye molecules) near it. We show that such energy transfer is very efficient, and with rate controlled through electrical gating.