Imaging molecular and atomic-scale materials in high-density liquids

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Direct visualistion and manipulation of nanomaterials at atomic-length scales is a well established process using scanning probe microscopy operated under ultra-high vaccum at cryogenic conditions. It would be highly desirable to achieve similar resolution under standard operating conditions at room-temperature, which will have a direct impact during nanoscale device engineering.

We report on real-space imaging of single-molecular and atomic-scale materials in a liquid environment at room-temperature with striking spatial and energy resolution. The structure, intermolecular interactions [1] and energy levels of single-molecules on ultra-flat metals are mapped in liquids using scanning tunneling microscopy and spectroscopy In addtion to single-molecules we extend our approach in resolving atomic positions and electronic bandstructure of single-atom thick materials such as graphene on metals [2] in high-density liquids. We quantitatively map bond-distances and point-defect density on monoatomic graphene and discuss possibilities in tuning atomic-scale contrast with chemically terminanted *d-band* metal probes.

References

[1] Peter N. Nirmalraj, Heinz Schmid, Bernd Gotsmann and Heike Riel, Langmuir, 29, (2013) 1340-1345.
[2] PN Nirmalraj and HE Riel, Materials Today, 17 (2013), 203-204.