Piezoresponse Force Microscopy (PFM): a technique to quantitatively evaluate the piezoelectric coefficient at the nanoscale

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In this study, we present the technique of piezoelectric force microscopy (PFM), which is based on the contact mode of AFM but employs a conductive tip to analyze the piezoelectric effect within the sample. In particular, we illustrate an innovative procedure able to quantitatively evaluate the piezoelectric coefficient (d_{33}). This study highlights how this procedure not only provides local insights but also offers a comprehensive global perspective on the piezoelectric response of the sample. To this end, we will compare the PFM measurements to those taken with a conventional shaker, showing how well the two measurements agree with each other. We will present several results, which include the characterization of zinc oxide (ZnO) nanostructures and polymeric nanocomposites such as for example Poly(vinylidene fluoride) loaded with graphene nanoplatelets (GNP), ZnO nano roads (NRs), different metallic hexahydrate salt (HMS) and poly(vinylidene fluoride-co-trifluoroethylene) (PVDF-TrFe) loaded with ferromagnetic nanoparticles of cobalt iron oxide ($CoFe_2O_4$).