Polymer nanobridge on a microfabricated quartz tuning fork

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A microfabricated quartz tuning fork (QTF) has been used to investigate the mechanical properties of polymer wire or membrane, and applied as a versatile gas sensor. Polystyrene (PS) or polymethylmethacrylate (PMMA) wire was formed between two prongs of quartz tuning fork (QTF). When the polymer wire-coated QTF is exposed to an ethanol vapor, the vapor absorption induced changes in the resonance frequency and dissipation factor are measured in situ, which are related to the changes in modulus and viscous damping, respectively. When ethanol vapor was absorbed into the PS wire which is not compatible with PS, the resonance frequency increased due to the shrinkage of PS chains. In contrast, PMMA wire swelled upon exposure to ethanol vapor, which decreases the resonance frequency of the QTF. When a PS-PMMA blockcopolymer wire was exposed to ethanol vapor, its modulus increased due to the PS block in the beginning, and then gradually decreased due to the PMMA block. The response time of the polymer wire-coated QTF was improved by decreasing the diameter of the wire. To improve the response time further, nanoporous microwire was used, which facilitates gas diffusion into the wire. The rapid and sensitive changes in the resonance frequency of the QTF demonstrate that QTFs are useful tools for the detection of various gases.