

Diamond RF MEMS for next generation mobile wireless

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Mobile phone manufacturers make extreme demands on the RF front-end (radio) in order to enable the constantly expanding functionalities of these devices. Currently mobile phones integrate voice, data, global positioning, and Wi-Fi connectivities while also offering many other features that are constantly expanding (e.g. streaming video). This is forcing the RF front-end into smaller and smaller volumes while also demanding greater broadband performance, reduced energy consumption, and compatibility with upcoming 4G and WiMax technologies well into the GHz regime. For several years RF MEMS devices based on silicon have been candidates for enabling such improvements in performance and integration, but have fallen far short of expectations due to the poor materials properties of silicon that requires expensive vacuum packaging and prohibit scaling to GHz frequencies. Diamond has long been recognized for its potential as a MEMS material for many applications including RF devices, but until recently has not been available as a wafer-scale technology mature enough to enable serious product development. Over the past several years Advanced Diamond Technologies, Inc. (ADT) has developed a new diamond thin film technology, UNCD[®] (ultrananocrystalline diamond), that provides a scalable wafer-based process enabling diamond films with exceptionally smooth and uniform properties to be grown onto wafers up to 200 mm in size. UNCD can be synthesized at temperatures low enough to be back-end-of-line compatible with microelectronics, enabling the direct integration of UNCD-based RF MEMS devices with the CPU. In this presentation the development of several RF devices, including piezoelectric-actuated UNCD RF filters and AC switches, will be discussed, as well as plans to replace individual SAW and FBAR components with integrated RF modules consisting of monolithically integrated UNCD filters. This work was supported in part by the National Science Foundation and the Defense Advanced Research Projects Agency (DARPA).