A novel composite system for ultra-efficient electromagnetic interference (EMI) shielding with frequency-selective absorption

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Herein, we propose a novel material system that provides efficient electromagnetic interference (EMI) shielding using two different types of spherical core-shell beads, where poly(methyl methacrylate) and polystyrene polymer cores are covered with diffuse reflecting nickel and wave-absorbing graphene, respectively. The core-shell bead composites were fabricated simply by mixing the beads with epoxy resin followed by compression molding. Thanks to the synergetic effects of the two types of beads, the composite has an excellent EMI shielding effectiveness of 96.5 dB, making it far superior to that of all other conductive polymer composites of comparable thickness. Furthermore, we report several significant scientific findings regarding the material's frequency selectivity, which is a unique phenomenon exerted by mono-sized spherical beads. We were able to control the absorption frequency range and selectivity of electromagnetic (EM) waves in the X-band frequency range by regulating the ratio of the two types of beads in the composite. This methodology has enormous potential for specially tailored EMI shielding applications with various types of matrices.