Supporting Information

Vertical interface augmented tunability of scattering spectra in ferromagnetic microwire/silicone rubber metacomposites

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1. The repeatability of Scattering properties of randomly dispersed short-cut $Co_{60}Fe_{15}Si_{10}B_{15}$ glass-coated microwires /silicone rubber composites

The good dispersion of microwires in the polymer matrix reflects on the repeatability of electromagnetic properties results when several samples are measured for each series. Figure S1 presents the transmission S_{21} for the composites containing randomly dispersed microwires of the same type as-cast (A) (Fig. S1(a)) and a combination of as-cast and annealed wires (Fig. S1(b)) repeated thrice at the same conditions. From Fig. S1(a), similar trends were observed for all the three tested composites, *i.e.*, a passband extending from 8.5 GHz to 11.5 GHz in the transmission spectrum. Similarly, for composites containing a combination of equal loading of as-cast A and annealed wires B (where B is 30 mA-annealed wire), two transmission windows were observed (Fig. S1(b)). The results repeatability of the composite samples shows that the dispersion of wires in the matrix is basically the same in all samples, hence showing almost identical transmission features with some minor amplitude differences. Such repeatability in results was also demonstrated in the other composite series.

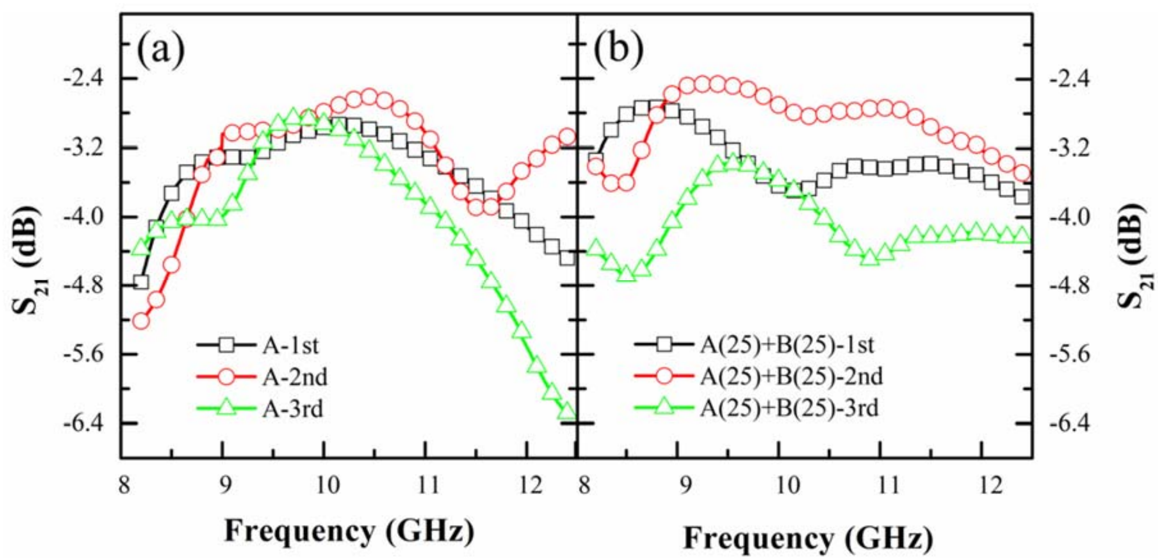

Figure S1: Transmission S_{21} of composites containing (a) same type wires A and (b) equal combination of as-cast A and annealed B randomly dispersed short-cut microwires. Three samples were prepared and tested for each series in order to demonstrate the repeatability of results.

2. Complex permittivity of randomly dispersed short-cut $Co_{60}Fe_{15}Si_{10}B_{15}$ glass-coated microwires /silicone rubber composites

By introducing vertical interfaces into the microwire composites significant contribution from interfacial polarization emerges. Such polarization is derived from the difference in dielectric properties between the two regions across the interface. Therefore, to further understand the effect of polarization on wave scattering, frequency dependence of complex permittivity is used here for analyzing the dielectric properties of vertical-interface microwire composites (Fig. S2). Six different representative composite samples were prepared which resulted in different states of polarization across the interface ($\Delta\varepsilon$) triggered by wire composition and filler microstructure variations. Sample 1 and 3 exhibit an almost constant response of permittivity regardless of frequency. A relaxation behavior of permittivity is then evidenced for the sample 2, 4 and 5 which turns into a resonance type for sample 6. These changes reflect the marked influence of the introduced vertical interface and filler impedance contrasts. Therefore, by considering the relative position of the interface and the wire concentration in the regions, each composite sample has a distinct $\Delta\varepsilon$, *i.e.*, different ability to restrict and accumulate charges, enabling tunable scattering responses.

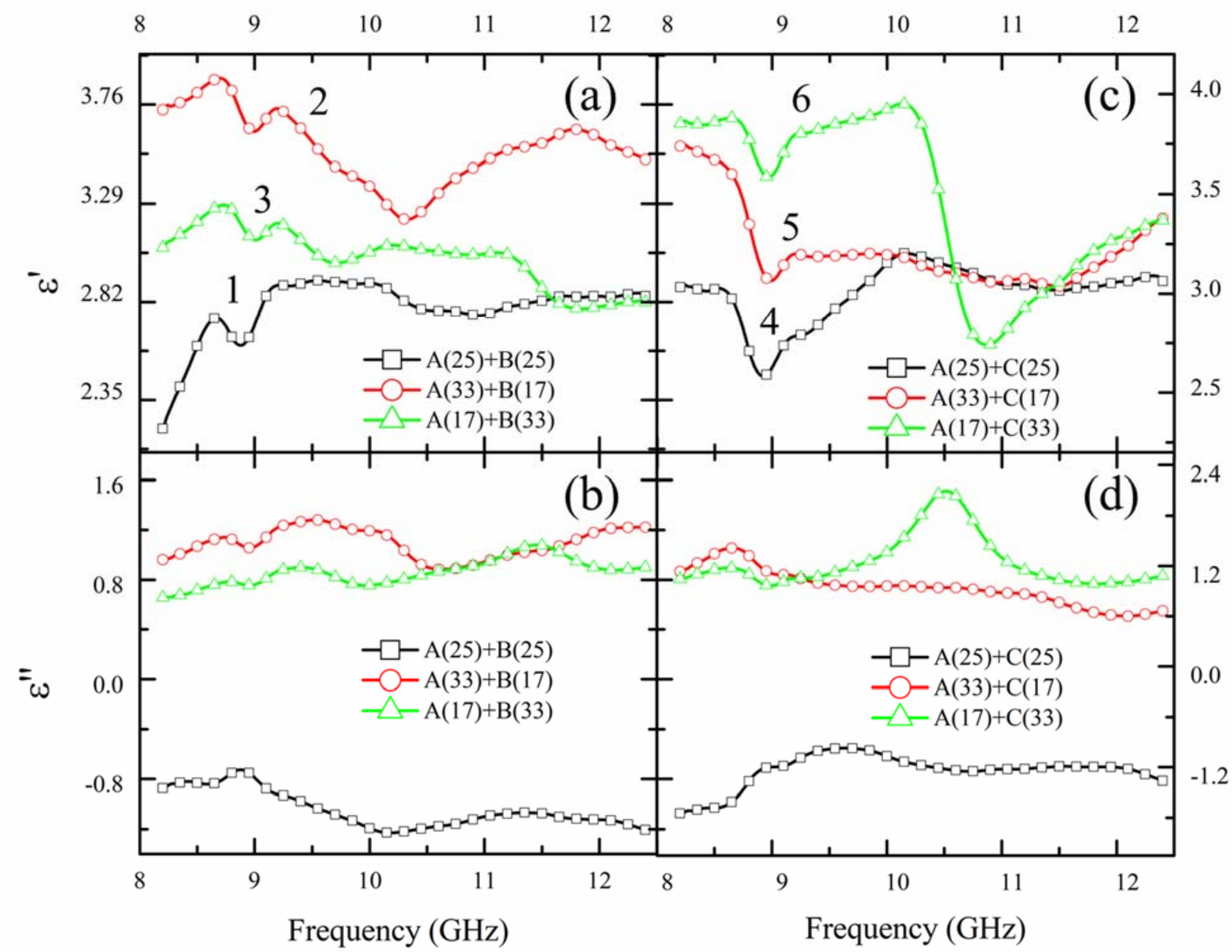

Figure S2: Frequency dependencies of the real and imaginary part of permittivity of composites containing randomly dispersed short-cut microwires in separate regions and different proportions: (a, b) as-cast A and annealed B wire under 30 mA; (c, d) as-cast A and annealed C wire under 40 mA.