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Microwave Dielectric Resonance and Negative Permittivity Behavior in Al_2O_3-CuO-Cu Nanocomposites[1] JEFFREY CALAME, JACOB BATTAT, Naval Research Laboratory, Washington DC 20375 — The frequency-dependent microwave (0.1-18 GHz) complex permittivity of nanocomposites based on the Al_2O_3/CuO/Cu system is investigated. The composites are formed by solution infusion of copper precursors into a porous Al_2O_3 matrix, followed by thermal decomposition to copper oxides and localized formation of $CuAl_2O_4$ spinels, and finally partial reduction by H_2 firing. The final material has a complicated microstructure and exhibits strong amplitude, relatively narrowband dielectric resonance in the microwave regime at intermediate concentrations ($\sim$15-18% by volume) of Cu. The resonances are superficially similar in structure to plasmon and Reststrahlen resonances typically seen in conductors at far-infrared to optical frequencies, but occurring at much lower frequencies in the composites. This is in contrast to the usual broadband induced-polarization dielectric relaxations observed in standard composites. Large concentrations of copper cause negative permittivity behavior below 6 GHz. Permittivity data, SEM micrographs, and possible explanations will be presented.

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