Microwave Dielectric Resonance and Negative Permittivity Behavior in Al₂O₃-CuO-Cu Nanocomposites¹ 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 Al₂O₃/CuO/Cu system is investigated. The composites are formed by solution infusion of copper precursors into a porous Al₂O₃ matrix, followed by thermal decomposition to copper oxides and localized formation of CuAl₂O₄ spinels, and finally partial reduction by H₂ firing. The final material has a complicated microstructure and exhibits strong amplitude, relatively narrowband dielectric resonance in the microwave regime at intermediate concentrations (~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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