

Good Performance of RT/duroid® 5870 Microwave Laminate in a Cryogenic Stripline Application at NASA

RT/duroid® 5870 laminate was evaluated as a stripline (triplate) transmission medium for use at cryogenic temperatures by workers at NASA-Langley Research Center, Hampton Virginia. Microwave signals in the 8 to 40 GHz frequency range were to be transmitted into a 4°K cryostat for amplification by an ultra low noise amplifier consisting of tantalum and lead elements deposited onto quartz substrate by electron beam plating.

Specimens of copper clad RT/duroid 5870 laminate 1 cm wide and 50 cm long were cycled repeatedly between 2.4°K and 290°K (17°C) by immersion in liquid helium. Adhesion of the copper foil remained sound. The electrical length changed very little. The material became "somewhat brittle" at the low temperature, as would be expected.

The insignificant change in electrical length over the temperature range of concern indicates an interesting balance of thermal behavior. The increase of dielectric constant due to increasing density with cooling is offset by the decrease in length of the transmission line due to the linear thermal coefficient of expansion in that direction. We have observed that PTFE composites of the RT/duroid 5870 type with low volume fraction of highly oriented microfiber reinforcement, show reduced ability of the oriented fiber to direct the volume change toward the Z direction at low temperatures.

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