Conductive Polymer-Carbon Nanotube Sheets for Conformal Load Bearing Antennas

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In this paper, we propose a conductive polymer-carbon nanotube (CNT) sheet for conformal load-bearing antenna applications. Polymer-ceramic composites (rubber like structures) provide us with good RF properties (high dielectric constant and low loss tangent) and desirable mechanical properties (conformal, flexible and light-weight). However, there is a challenge of direct printing on polymers since the traditional printing methods are unable to achieve strong adhesion and metal-polymer compatibility under stretch. Therefore, we propose a new conductive CNT sheet embedded inside polymer composite for conformal load bearing antennas. The ruggedness of the CNT sheet make it strongly adhesive to the polymer surface even under severe strain, stretch and bending. We built and tested the performance of a sample polymer-CNT patch antenna, which yielded a gain of 5.6 dB. This is only 1 dB lower than that of an ideal patch made of perfect electric conductor (PEC). We also carried out tests to evaluate electrical performance of the polymer-CNT sheets as they were bent and stretched. Our test results show that the proposed conductive polymer-CNT sheet is highly flexible and preserves good conductivity under strain and small stretch. However, the conductivity is significantly reduced as the CNT sheet is elongated more than 5%. We are currently employing two different techniques based on metal nanoparticles sputtering and entangled non-aligned CNTs to tackle this challenge.