Green Interpenetrated Silicone-Based Elastomeric Webs Engineered as Wave Energy Harvesters

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Wave energy extraction using dielectric elastomers is a recently developed technology with a lot of potential. The system used is made from a dielectric elastomer coated on both sides with electrodes, thus forming a capacitor capable of converting mechanical energy into electrical energy. Systems of this kind based on silicone elastomers are studied due to their very good properties: high flexibility, low toxicity, operation at different temperatures. The aim of the project is to improve the efficiency of the conversion of mechanical energy into electricity by developing new materials with favorable mechanical properties (elongation at break, dielectric permittivity). Two polymeric networks were synthesized, namely HEP (polydimethylsiloxane with hydroxyl groups at the ends) and VEP (polydimethylsiloxane with vinyl groups at the ends). Combining these two components in various mass ratios (1: 1, 1: 2, 2: 1, 1: 4, 4: 1) several interpenetrated networks were obtained. For this purpose, we used an elastic network formed by the reaction of the HEP polymer with tetraethyl orthosilicate (TEOS) and a rigid network formed by the reaction of the VEP polymer with a siloxane oligomer with mercapto functions. The interpenetrated networks obtained were cast in the form of thin membranes and characterized by the following methods: atomic force microscopy, electron microscopy, dielectric spectroscopy and determination of elongation relative to rupture. The transformation of mechanical energy into electrical energy was analyzed by placing the membranes between two electrodes and connecting the system to an oscilloscope. A 50g ball was dropped on the membrane from 3 different heights (5, 10, and 15cm) and the voltage developed between the electrodes was read from the oscilloscope.

Awards Won:

Arconic Foundation: 2nd Award