

## SYNTHESIS AND INVESTIGATION OF THERMOELECTRIC PROPERTIES OF POLYANILINE AND NICKEL

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The Peltier module is a *p-n* junction, which consists of two dissimilar thermoelectric materials (TEs) generating a temperature difference as a result of an applied voltage across the junction. Due to the hazardous nature of best-known TEs, such as Bi<sub>2</sub>Te<sub>3</sub> and Sb<sub>2</sub>Te<sub>3</sub>, an attempt has been made to search for new TEs. Investigation of conducting polymers as TEs has become of interest due to their environmentally friendly nature, and a wide range of easily tunable electrical and thermal properties. In this study, an effort was made to utilize polyaniline (PANI)/nickel (Ni) as a *p-n* junction for a Peltier module with optimized thermoelectric parameters. Pressed pellets of PANI powder, which was synthesized using a chemical method doped with HCl aqueous solutions of 1 M and 2 M, were used as the *p*-type material, and both pressed pellets of Ni powder and a sheet of Ni metal were tested as the *n*-type material. The synthesized PANI was characterized by Fourier-transform infrared spectroscopy (FTIR), and FTIR bands were observed corresponding to polyaniline emeraldine salt at 1,559.2 cm<sup>-1</sup> and 1,306.5 cm<sup>-1</sup>. The band observed at 1,135.9 cm<sup>-1</sup> was characteristic to conductive PANI. Electrical conductivity, thermal conductivity and Seebeck coefficient were measured, and figure of merit, Lorentz number and power factor were calculated for both individual materials, PANI and Ni as well as for the constructed junction. The metal and powder pellets showed negative Seebeck coefficients of -13.5 μV K<sup>-1</sup> and -13.7 μV K<sup>-1</sup>, respectively, and PANI pellets doped with HCl of 1 M and 2 M aqueous solutions showed positive Seebeck coefficients of 253.3 μV K<sup>-1</sup> and 157.8 μV K<sup>-1</sup>, respectively, being consistent with the standard values. PANI doped with HCl from 1 M aqueous solution showed a better Seebeck coefficient than that with HCl from 2 M aqueous solution leading to a higher power factor of 0.074 W m<sup>-1</sup> K<sup>-2</sup> compared to 0.054 W m<sup>-1</sup> K<sup>-2</sup>, and figure of merit of 1.95×10<sup>-5</sup> compared to 6.14×10<sup>-6</sup>. Individual thermoelectric parameters of chemically synthesized PANI and Ni were better than that of the junction, suggesting the method of the junction construction be improved.

**Keywords:** Figure of merit, Power factor, Polyaniline, Seebeck coefficient, Thermoelectricity