Study of the physical properties of diphenyl carbazide doped with Ruthenium

Thesis

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Abstract

The thermal analysis (DSC and TGA) as well as the electrical measurements (R, ε' and ε") for DPC organic compound, clearly reveals the thermal stability up to the melting point ≈ 162 ^{o}C. The electrical parameters of DPC sample (R, ε' and ε") show a little change with the effect of increase of the temperature (due to the high ordering properties of DPC), leading to decrease in ionic mobility and accompanied by a large change which is due to the disorder process from the weaking bonding of the hydrogen in the amino ions (N-H) to the carbonyl (C=O) ions.

The variation in the modes of a new ruthenium diphenyl carbazide complex (RuDPC) during changing of ruthenium (Ru) concentration within $0.01 \leq X \leq 0.09$ in diphenyl carbazide (DPC) are investigated using IR analysis. Variation in some IR spectroscopic parameters during the increase of Ru content in pure DPC has been recorded. The variation in both the relaxation time and the rotational energy barrier for RuDPC samples at the modes 505 cm^{-1},748 cm^{-1} and 883 cm^{-1} supports changes that occurs at $X \approx 0.05$.

The obtained data from the thermal and electrical measurements for RuDPC are completely different from the thermal and electrical parameters of the parent material (DPC) which is attributed to the replacement of Ru metal by the hydrogen in this compound through the amino ions (N-H). DSC and TGA thermograms reveal a thermal decomposition after a certain range of temperature effect. The rate of variation of electrical parameters (R, ε' and ε") is accompanied by a high change with the effect of increasing of temperature which is due to the lattice dipole which could become relatively distorted and leading to increase the polarizability accompanying by enhancement the mobility of RuDPC complex.

Micro-structure of RuDPC samples was studied by X-ray analysis and scanning electron microscopy. Moreover, SEM pictures and EDAX measurements were made revealing the strong Ru-signals indicating the presence of Ru and their distributions in the DPC matrix. Also results indicated that Ru inclusion in DPC matrix changes its morphology with a uniform distribution of Ru. Besides, X-ray diffraction patterns revealed RuDPC samples are represented by a mixture of amorphous and crystalline structure, wherever the phase-nature crystallization of RuDPC samples reinforced when the concentration of Ru is augmented. The crystal structure is changed to tetragonal structure after addition of ruthenium metal to pure orthorhombic DPC matrix. The spectroscopic properties of RuDPC complex are seemed to be depended on its characteristic to the effect of radiation (FTIR), as a solar material in the application of this field, due to DPC is a photosensitive material, the increase in the mobility caused by the substitution of hydrogen with Ru metal and the enhancement of the polarization process, due to the formation of the delocalized state in the RuDPC complex. So that there are a number of optical applications which depend upon optically induced structure transition energy states for the complex.

Promising solar cells in which will made of RuDPC complex will be regarded as potential alternatives to solar cells, owing to their simple structure and low fabricating cost. Solar cells are photovoltaic devices that are used to convert light energy into electrical energy by the use of organic dyes (photosensitizers) and semiconductors.