SUMMARY

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- One of the major problems of polymer science is to set up a complete analysis of the composition, structure and the correlation between them and physical properties of a given polymer. The characterization of the physical properties of polymers is considered one of the most convenient and sensitive methods of studying polymer structure. Accordingly, factors which have applicable effect on the polymer structure must be carefully studied. In particular, the electrical properties, thermal analysis (TGA and DSC), reactivity ratio determination, I.R spectrum and X-ray diffraction are some of these important factors.

- The main objects of the present study are Polyindene (PIn), polyacrylonitrile (PAN) and polyacrylic acid (PAA). Indene has been selected as a common monomer with the two different vinyl monomers because it has wide use in the field of technology. The incorporation of five member planar ring of the indene monomer into the backbone chain could lead to copolymers of great stiffness as well as higher thermal stability.

- All the test samples were prepared by free radical polymerization mechanism. Azobisisobutyronitrile (AIBN) was used as initiator in the polymerization of PAN, PAA

and all the copolymers with the different mol% of the monomers composition; however conc. H_2SO_4 was used to initiate the indene. The copolymerization was done at 60 °C in a water thermostat with periodical shaking for a definite time. Then the prepared samples filtered, & finally dried at 50 °C to a constant weight.

- The reactivity ratio r_1 of indene and r_2 of other monomers were calculated according to two different methods; Finman and Ross and Kelen and Tüdos methods. The product of r_1r_2 serves as a measure for the tendency of alternation of two monomers in the polymer chain. Perfect alternation is achieved where $r_1r_2=0$. The high tendency for alternation is in the binary system of In/AN copolymers.

- The most important feature of the FTIR is the absence of the absorption band at 1640 cm^{-1} characteristic of the carbon-carbon double bond, in all the investigated samples which clearly indicates that a true homopolymer and a copolymer are formed in all cases. The appearance of the bands at 2875-3080 cm^{-1} region can be assigned to the aromatic and aliphatic C-H stretching modes. Also, the appearance of the band in 744-750 cm^{-1} of the substitution five adjacent hydrogen atoms and the absorption band at 1724 cm^{-1} and 1631 cm^{-1} of the carbonyl groups (C==O). The bands in 2235 cm^{-1} and 1660 cm^{-1} for the CN stretching and bands in 1708 and 1652 cm^{-1} for the

carbonyl groups of the carboxylic acid. Therefore all the observational bands are evidence for confirming the formation of indene copolymers with acrylic acid and acrylonitrile respectively.

- The obtained results of the thermogravimetric analysis revealed that polyindene has a relatively high thermal stability in addition to improve the thermal properties of the prepared polymer. Polyindene shows a thermogram with an initial decomposition temperature (IDT) at 480 °C and the final decomposition temperature occurred at 600 °C. The initial decomposition of polyacrylonitrile and the copolymer of In/AN of 30/70 mol% are 280 °C and 300 °C respectively, and the final decomposition temperature for the same sample at 400 °C and 500 °C respectively. The initial decomposition temperatures of polyacrylic acid and the copolymer of In/AA of 30/70 molar ratio are 250 °C and 270 °C respectively, while the maximum decomposition at 300 and 300 °C respectively. Polyindene showed a good thermal stability and an improvement of the thermal stability of AN and AA also. The system of In /AN give more advanced material than In/AA because PAA is easy to decaroxylate by losing COOH group.

- DSC thermogram shows that Polyindene posses the highest glass transition temperature. Thus the T_g of the

different copolymer increases as the mol% of the indene in the copolymer increases. Also from the thermogram, we determine the thermal conductivity at each peak for each sample. It was found that the thermal conductivity K of the samples increases with increasing the temperature.

- The AC electrical conductivity of all the investigated samples was measured using the RLC bridge mode Hioki 3531 Hitester. The measurements were made at different frequencies ranged from 100 KHz to 1 MHz and at different temperatures from 20 °C to 160 °C. The results of the AC conductivity for the homopolymers revealed the existence of four regions of conductivity. However the AC conductivity of the copolymers revealed the existence of two linear dependence of the conductivity. The results showed that the AC conductivity of the In/AN copolymers at fixed frequency for all the samples decreases as the mol% of the indene in the copolymer increases. However AC conductivity of the In/AA copolymers increased with increasing the mol% of the indene in the copolymer.

- The DC electrical conductivity of the entire sample was measured by using a potential drop method at different temperatures from 20 °C to 160 °C. The obtained results revealed that all the investigated samples posses semiconducting behavior. Also the DC conductivity of each of the samples took the same behavior as its AC one.

- The activation energy at low temperature region E_1 and high temperature region E_2 was calculated for all the samples and the results cleared that the activation energy decreased with increasing the frequency for all the samples. It was found also that DC conductivity has larger values of the activation energy than that of the AC one.

- The temperature dependence of the real part and imaginary part of the permittivity έ and ε" was observed at different frequencies ranged from 100 KHz to 1 MHz. It was found that the imaginary part of the homopolymers describes a similar behavior to that of the real part of the relative permittivity, with the existence of two well resolved relaxation peaks. The most prominent feature of ε" was the existence of only one relaxation for all the samples of the In/AN copolymers except one sample with mol % 50/50 of In/AN for which ε˝ has two relaxation peaks. It was also showed that the maximum value of ε˝ (ε_{m}˝) decreases as the mol% of indene in the monomer composition increases in all frequencies. In the variations of the dielectric loss factor ε˝ of the In/AA copolymers as a function of the temperature at different frequencies ranged from 100 KHz to 1 MHz two main relaxation regions were detected. The location and the strength of these relaxations were observed. In addition it was found that the values of ε''_m are dependent on the frequency, as with decreasing the frequency, ε''_m is increased.