

Effect of Heat Treatment Condition on Fine Structure of High Strength Weight Polyacrylonitrile(PAN) Fibre

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The heat treatment process of high strength polyacrylonitrile (PAN) fiber manufactured from acrylonitrile(AN) homopolymer having high molecular weights is necessary to develop high performance carbon fiber.

In this study, we investigated the effect of molecular weight in the $IV=2.5-5.5\text{dl/g}$ on the change of fine structure of high strength PAN fibers with heat treatment condition during oxidation process. The change of fine structure and thermal properties was examined by differential scanning calorimeter(DSC), rheovibron, element analyzer and X-ray methods etc.

The change of dimension of PAN fibers treated at below 280°C x1hr during oxidation process may be showed that the oxidation reaction is intramolecular and not intermolecular. The activation energies for the thermal reactions were estimated by the dynamic DSC method and it used to be determined aromaticity. The PAN precursor with low molecular weight has a higer aromatization(AI value) due to its rapid cyclization during oxidation process. The increase in formation of ladder polymer is confirmed by X-ray studies. The crystal size($2\theta=16.9^\circ$) of heat treated PAN fiber increased continuously until the heat treatment temperature and time reach to this condition(260°C x1hr), but it decreased remarkably between 260°C and 280°C , AN units at the boundary of ordered phase of PAN fibers start forming to ladder polymer

structures.

In the dynamic mechanical behavior, the intensity of beta peak appeared at 110°C on the loss tangent curves decreased with increasing molecular weight and heat treatment time, and when treated at above 280°Cx50min, this beta peak of PAN fibers had much lower absorption. The alpha peak due to the chemical reaction occurring in the AN units decreased with increasing molecular weight.