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Durable PAN Gels Prepared by the Thermal Treatment to PAN Fibers

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Fiber type polyacrylonitrile gel for short PAN gel has a quite robust mechanical strength for a gel unlike most of other gels. Owing to its fine diameter, it exhibits an extremely fast length change, too, by the acid-base solution exchange, where it contracts in the acidic solution and elongates in the basic solution. In addition to that, the length change ratio is quite large. These robust mechanical strength, fast length change, and large length change ratio are unusual for a gel. Therefore a number of researchers have been involved in the investigation on it aiming at developing it into an artificial muscle or a gel actuator. Such an attractive gel, PAN gel was developed into a sheet shape successfully recently. For the purpose of using a sheet type PAN gel as an actuator material, its length change ratio and generated force should be evaluated quantitatively. Several sheet PAN gels were prepared by changing the condition of thermal treatment employed for the preparation of each of them. Their length change ratio and generated force induced by the acid-base bathing solution exchange were measured. A quite large length change ratio was observed, and it is comparable to that observed for a fiber PAN gel. Although its length change speed was not as fast as that of a fiber PAN gel, it was expected, since the thickness of sheet PAN gel is not as thin as the diameter of PAN fiber. PAN gel length change is caused by its solution absorption and expel, therefore thicker matrix of sheet PAN gel deaccelerates its contraction and elongation speed. Since the matrix of sheet type PAN gel is not robust enough in the basic solution, it's hard to make it thinner, namely it's easily torn apart. The generated force of PAN gel is not so large and it's not comparable to that of a fiber PAN gel. As a whole, the performance of sheet PAN gel is not sufficiently high for its use as an actuator material and is inferior to that of a fiber PAN gel. However, in a particular environmental condition, some sheet type PAN gel property becomes better. It lets us envisage the large possibility of improvement of sheet PAN gel performance through the further investigation on it.