

Studi Pendahuluan Sistem Higroelektrik Berbasis Polimer = Preliminary Study of Polymer Based Hygroelectric System

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Abstrak

Penelitian ini bertujuan mengevaluasi performa sistem generator higroelektrik berbasis polimer menggunakan elektroda aktif Polianilin (PANI) dan tiga jenis film higroskopis, yaitu Poly(sodium 4-styrenesulfonate) (PSSNa), Poly(2-acrylamido-2-methyl-1-propanesulfonic acid) (PAMPS), dan reduced Graphene Oxide (rGO). Prinsip kerja sistem ini didasarkan pada perbedaan kelembapan udara yang menciptakan gradien konsentrasi ion, mendorong migrasi ion, dan menghasilkan beda potensial antara elektroda. PANI disintesis melalui polimerisasi anilin dalam suasana asam dan dimodifikasi menjadi tiga bentuk berdasarkan tingkat doping: emeraldine salt (ES), emeraldine base (EB), dan campurannya (ESB). Ketiga jenis elektroda ini dibandingkan performanya dengan elektroda inert (pasta perak). Hasil menunjukkan bahwa kombinasi elektroda PANI ES dan film rGO menghasilkan tegangan tertinggi, disusul oleh PANI ESB. PANI EB dan elektroda perak menunjukkan performa rendah. Temuan ini mengindikasikan bahwa tingkat doping memengaruhi konduktivitas PANI dan efisiensi konversi energi. Karakteristik film higroskopis juga berpengaruh, dengan rGO menunjukkan kestabilan dan efisiensi tertinggi dibandingkan PSSNa dan PAMPS. Performa tegangan tertinggi didapat dari kombinasi elektrolit rGO dengan elektroda PANI ES, yaitu sebesar 90.282 mV. Adapun daya terbesar didapat dari kombinasi elektrolit PAMPS dengan PANI ES, yaitu sebesar 156.25×10^1 W. Kombinasi ini juga menghasilkan kepadatan daya terbesar dari kombinasi lainnya, yaitu sebesar 0,0104 W/cm² (@ 1 x 10⁴). Studi ini menunjukkan adanya pengaruh penggunaan elektroda aktif dalam suatu sistem generator higroelektrik.

.....This study aims to evaluate the performance of a polymer-based hygroelectric generator system using Polyaniline (PANI) active electrodes and three types of hygroscopic films, namely Poly(sodium 4-styrenesulfonate) (PSSNa), Poly(2-acrylamido-2-methyl-1-propanesulfonic acid) (PAMPS), and Reduced Graphene Oxide (rGO). The working principle of this system is based on the difference in air humidity which creates an ion concentration gradient, encourages ion migration, and produces different potentials between electrodes. PANI was synthesized through the polymerization of aniline in an acidic atmosphere and modified into three forms based on the doping level: emeraldine salt (ES), emeraldine base (EB), and their mixture (ESB). The performance of these three types of electrodes was compared with an inert electrode (silver paste). The results showed that the combination of PANI ES electrode and rGO film produced the highest voltage, followed by PANI ESB. PANI EB and silver electrode showed low performance. These findings indicate that the doping level affects the conductivity of PANI and the energy conversion efficiency. The characteristics of the hygroscopic film also have an effect, with rGO showing the highest stability and efficiency compared to PSSNa and PAMPS. The highest voltage performance was obtained from the combination of rGO electrolyte with PANI ES electrode, which was 90.282 mV. The highest power was obtained from the combination of PAMPS electrolyte with PANI ES, which was 156.25×10^1 W. This combination also produced the highest power density of the other combinations, which was 0.0104 W/cm² (@ 1 x 10⁴). This study shows the effect of using active electrodes in a hygroelectric

generator system.