Development of a Small Wind Turbine with Airflow Control Technique Using a Plasma Actuator

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In recent years, wind power has attracted attention as a renewable energy source, but there are problems concerning its energy efficiency and stability. One of the keys to solving these problems is to improve the performance of the turbine blade via flow separation control. In this study, we have developed a small wind turbine using a plasma actuator (PA) with the purpose of improving the energy efficiency and stability of the wind turbine. The experiments were performed in two steps. First, we performed wind tunnel experiments to investigate the performance of the airflow control by the PA. We made the wind-tunnel, the turbine blade model, and flow visualization system. The performance of the PA was evaluated by measuring the change in the separation area behind the airfoil. Second, we designed a small wind turbine and PA system and performed experiments to determine wind power generation using an air blower. The results show that the PA attached at the leading edge changes the direction of the airflow and reduces the separation area by approximately 10% at all angles of attack. In addition, the generated power was shown to have increased by approximately 4 to 7% with the PA. These results show that the addition of a PA can improve both the energy efficiency and the stability of a small wind turbine.

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