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TAILORED MULTILAYER STACK ACTUATORS FOR HARSH ENVIRONMENT

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Summary: This paper presents the development process of an electrically insulating and liquid-impermeable coating for piezoelectric actuators. Against the background of flow investigations of an adaptive airfoil in a water tunnel the adaptive lip including PZT-ceramics for the active lip deformation must be insulated and sealed up against the ingress of moisture. Due to high electric field strength of 2 kV/mm between electrodes of multilayer actuators an ingress of moisture would lead to a reduction of the dielectric strength and may cause a short circuit. In order to prevent failure of the adaptive lip the electrical connections of the actuators have to be insulated by a waterproof coating. A service life of at least 10^7 load cycles at a frequency of 100 Hz is required for the actuators. Therefore the coating should be as ductile as possible otherwise it could break and water could diffuse into the actuators. That is why the yield strength of the coating has to be higher than of the actuators, which is 0.3%. For the investigation of the waterproofness several samples are coated with different materials in various processes. First the actuators are moulded in epoxy resin and then a diffusion-resistant PVF-foil is applied. After a screening of different materials, an additional coating with a two-component tar-epoxy resin in combination with a sputtered gold coating applied by a PVD process seems to be the most suitable process. Another promising waterproof coating is the atomic layer deposition (ALD). It is a slightly changed chemical vapor deposition (CVD) and referring to the studies of A. I. Abdulagatov et al. an ALD of aluminum oxide (Al2O3) and titanium dioxide (TiO2) can slow down the corrosion of static copper specimens in water for ~80 days. Through a redrying procedure during test intermissions an extended underwater application of the piezoelectric actuators is expected.