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Piezoelectric MEMS: Materials, Devices and Applications

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In a compact introduction, I will motivate the benefits of piezoelectric thin films for MEMS and will give a short overview to state of art application scenarios on device level. Next, I will highlight latest results on the electrical, mechanical and piezoelectrical characterization of sputter-deposited aluminium nitride (AlN) including the impact of sputter parameters, film thickness and substrate pre-conditioning [1,2]. I will present the impact of doping of AlN with scandium, which leads to an increase of the moderate piezoelectric coefficient of AlN up to a factor of four. In a next step, these films are implemented into fabrication processes of cantilever-type MEMS devices. In combination with a tailored electrode design, resonators are realized featuring Q factors up to about 300 in liquids covering the frequency range of 1-2 MHz. This enables the precise determination of the viscosity and density of fluids up to dynamic viscosity values of almost 300 mPas [3]. Besides this application, such high Q factors are useful when targeting mass-sensitive sensors, thus paving the way to e.g. particle detection even in highly viscous media. Given the low increase in permittivity of ScAlN compared to AlN, another field of application for this material are vibrational energy harvesters, where the benefit of ScAlN compared to pure AlN is demonstrated [4]. Finally, I will present some selected results of ScAlN thin films within SAW devices ranging from high temperature applications to droplet manipulation in microfluidics [5].

References:
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Keywords
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