

21. A piezoelectric ceramic actuator comprising:

multiple metal electrode layers; and

multiple piezoelectric ceramic layers, wherein the multiple piezoelectric ceramic layers comprise d_{31} -mode piezoelectric layers, and wherein a polarization of the d_{31} -mode piezoelectric layers is substantially perpendicular to a direction of utilized displacement of the piezoelectric ceramic actuator upon charging of the piezoelectric ceramic actuator, and

wherein the d_{31} -mode piezoelectric layers comprise a ceramic composition having a sintering temperature of 950 °C or below, and

wherein the multiple metal electrode layers comprise metal selected from the group comprising silver (Ag), a silver palladium alloy (Ag/Pd alloy) having a low palladium concentration of ≤ 10 wt%, nickel, a nickel alloy, copper, or a copper alloy.

22. The piezoelectric ceramic actuator in accordance with Claim 21, wherein the composition of the d_{31} -mode piezoelectric layers has a perovskite phase which is substantially away from a morphotropic phase boundary.

23. The piezoelectric ceramic actuator in accordance with Claim 21, wherein the composition of the d_{31} -mode piezoelectric layers includes $0.1\text{Pb}(\text{Ni}_{1/3}\text{Nb}_{2/3})\text{O}_3$ - $0.35\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{O}_3$ - $0.15\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$ - 0.1PbZrO_3 - 0.3PbTiO_3 with 4 mol% excess NiO (0.1PNN-0.35PZN-0.15PMN-0.10PZ-0.3PT-0.04NiO).