
# Electroceramics XIII

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| P.21 | **Optimal matching and interfacing of piezoelectric acuators within mechatronic applications**<br>Jan Holterman[1], Theo de Vries[2]<br>[1]Engineering Department, imotec b.v., Hengelo, Netherlands; [2]Robotics and Mechatronics, University of Twente, Enschede, Netherlands |
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Successful use of piezoelectric actuators in mechatronic applications depends on three key factors in the conceptual design stage. First of all appropriate quantitative requirements need to be derived. Secondly, the piezoelectric actuator needs to be chosen to appropriately match the performance requirements, within both the available space and the allowed cost budget. Thirdly, the mechanical interface should be designed so as to ensure correct loading of the piezoelectric actuator. The impact of the mechanical interface often necessitates reconsideration of the quantitative requirements and thus leads to iterations in the search for the optimal piezoelectric actuator.

In order to facilitate the iterative analysis and design process, the quantitative requirements can appropriately be expressed as characteristic lines and points in the so-called force-stroke diagram. This diagram allows for a transparent analysis of the key factors in the design problem, and as such for an optimal choice for the piezoelectric actuator in terms of e.g. design space, cost, and energy consumption.

This iterative design approach, with a central role for the force-stroke diagram analysis, will be illustrated for two mechatronic applications:

- a piezoelectric actuated valve, based on a $d_{31}$ ceramic multilayer bender
- a piezoelectric stepping device., based on a $d_{33}$ ceramic multilayer stack actuator

| P.22 | **Development and electrical characterization of conductive Ti —Magneli phases for sensing applications**<br>Vaia Adamaki, Andrew Dent<br>[1]Mechanical Engineering, University of Bath, Materials Research Centre, Bath, United Kingdom, BA2 7AY |
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This research aims to understand the electrical properties of conductive titanium based Magneli phases ($Ti_nO_{2n-1}$, 3 <n< 10) fibres and determine the processing factors that influence their properties. $TiO_2$ powder (99.5%, 0.3 μm) was initially processed in order to obtain green bodies in both tablet and fibre form. The tablets were formed by uniaxial pressing with an average diameter of 10 mm and for the fibres a ram extruder was used with a die of 300 μm. Sintering conditions were optimized to achieve high sintered density and control the grain size and the electrical properties. To produce the reduced Magneli phase, the sintered $TiO_2$ was subsequently subjected to a carbothermal treatment under an argon flow (typically at 1300°C for 6h). Various reduction conditions were investigated to prevent grain growth during the reduction treatment and observe changes in the electrical properties. The average density of the Magneli phases was 97% of theoretical. The ac conductivity and permittivity were determined over a broad range of temperature (up to 1000°C for $TiO_2$ and 375°C for $Ti_nO_{2n-1}$ ) and frequencies using impedance spectroscopy. For the electrical measurements platinum, aluminium and silver electrodes were evaluated in order to achieve an optimum electrical contact. The characterization and development of highly conductive Magneli phases materials will enable the production of fine scale, robust devices for novel sensing applications.