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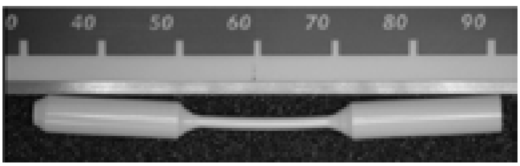
Ceria-stabilized zirconia-based composites as an alternative to titanium and yttria-stabilized zirconia in the dental field

Titanium (Ti) and its alloys have been used for long in dental implants fabrication because of their high strength, biocompatibility, good osseointegration and resistance to corrosion. However, Ti-based dental implants can be visible in the oral cavity (aesthetic issue), produce Ti particles that will be fixed in both soft and hard surrounding tissues (debris generation issue) or create immunological response and allergies (biological complications). Consequently, because of these drawbacks, yttria-stabilized zirconia ceramics (3Y-TZP) started to be used as an alternative to Ti implants. However, due to the possibility of 3Y-TZP aging (especially when the robustness of the whole ceramic processing step is low) and therefore to the risk of implant failure, alternatives to 3Y-TZP have been also developed. In this work, a novel very-stable zirconia-based system will be presented. These ceramics are composed of ceria-stabilized zirconia (Ce-TZP) and two second-phases, alumina (Al_2O_3) and strontium aluminate (($SrAl_{12}O_{19}$). During the oral presentation, the mechanical behavior (strength, fracture toughness, ductility and transformability) and aging resistance (Low Temperature Degradation) of these triphasic ceramics will be discussed and related to the microstructural features and/or composition (content of stabilizing agent and second phases) and compared to Ti-based and 3Y-TZP materials. For some compositions, materials have exhibited a remarkable plasticity for a ceramic (ε~1%), very high Weibull modulus (m>60) and a low sensitivity to fatigue (fatigue limit of more than 90% of the tensile strength). The up-scaling process for Ce-stabilized zirconia based dental implants fabrication and main encountered issues will be also discussed.



Biography

Helen Reveron is a Research Scientist at the French National Center for Scientific Research (CNRS). Since 2006, she works at the MATEIS Laboratory of INSA- Lyon in the development and characterization of ceramic nanocomposites with controlled micro-nanostructures. Before coming to Lyon, she earned an Engineer's Degree in Materials Science from USB-Caracas-Venezuela (1996) and a Ph.D. in Ceramics and Surface Thermal Treatments from ENSCI-Limoges-France (2000). She then worked at as Assistant Professor (Materials Science Department, USB-Caracas) and was interested in the hydrothermal synthesis of oxide nanoparticles, before coming-back to France in 2003. For 3 years, she worked at the ICMCB-CNRS (Chemical Institute of Condensed Matter, Bordeaux, France) in the continuous supercritical synthesis of ferroelectric nanoparticles and the processing/characterization of nanostructured ceramics obtained through SPS (Spark Plasma Sintering). She is the author of more than 40 papers and 5 patents.

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