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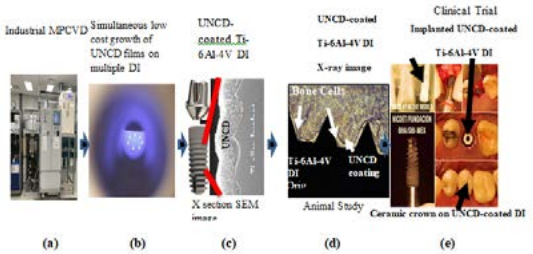
Orlando Auciello

University of Texas at Dallas, USA

Materials science / technology development / clinical trials for transformational new generation metal dental implants coated with unique low cost / biocompatible / oral fluids corrosion resistant ultrananocrystalline diamond (UNCD) coating

Currently, about 90% of commercial dental implants marketed worldwide are made of Ti-6Al-4V alloy. A key problem is that Ti-6Al-4V alloy inserted in the maxillary bone already has a TiO2 layer grown upon exposure of the Ti-alloy surface to atmosphere. Pioneering research by Auciello's group demonstrated that Ti-alloy surface exhibits electrochemical corrosion from oral fluids, releasing TiO2 particles from the oxidized surface, causing cells' death, tissue inflammation and implant failure (15% Ti alloy-DIs fail, worldwide, in 4-5 years), requiring replacement, with patients' discomfort and extra cost. Microwave Plasma Chemical Vapor Deposition (MPCVD) (Fig. 1 (a)) system enabling coating of hundreds of DIs, vertically distributed in circular pattern, in a single low-cost fabrication process. which create a plasma containing Ar0 neutral atoms, Ar+ ions, CHx0 (x=1,2, 3) neutral molecules and CHx+ ions, which upon landing on the surface of the Ti-alloy induce the chemical bonding of C atoms with the sp3 diamond-type bonds, producing the UNCDTM film growth. A uniform plasma is produced around all implants (Fig. 1(b)) resulting in extremely uniform /dense UNCD films shown by SEM analysis. (Fig. 1 (c)). Chemical analysis showed that UNCDTM-coated DIs are not corroded, as Ti alloy-DIs, in artificial saliva. Histological studies of UNCD-coated Ti-alloy DIs, via in vivo animal model, showed very good biocompatibility and osseointegration (Fig. 1(d)), order of magnitude better than Ti alloys-DIs. Figure 1 (e) shows a UNCD-coated DI inserted in human maxillary bone, and after 3 months, respectively, before crown insertion. Clinical trials (X-ray in Fig 1 (e) top left) and implantation -Fig. 1(e) middle right) conducted by Dr. López-Chávez in México demonstrated that UNCD-coated commercial Ti-6Al-4V DIs provide a new revolutionary DI technology.



Biography

Orlando Auciello graduated with MS (1973) and PhD (1976) degrees in Physics from the Physics Institute "Dr. Balseiro" (Universidad Nacional de Cuyo-Argentina). EE-University of Córdoba-Argentina (1970). Researcher-University of Toronto-Canada (1979-1984), Associate Professor-NCSU-USA (1985-1988), Distinguished Scientist-MCNC-USA (1988-1996), Distinguished Argonne Fellow (1996-2012)-Argonne National Laboratory-USA. Currently, he is Distinguished Chair-University of Texas-Dallas. He is directing basic and applied research programs on multifunctional oxide and novel ultrananocrystalline diamond (UNCD) thin films and application to industrial, high-tech, and medical devices. The UNCD film technology is commercialized for industrial products by Advanced Diamond Technologies, founded by he and his colleagues, (2003, profitable in 2014), and by Original Biomedical Implants (OBI-USA, 2013) and OBI-México (2016) for medical devices. Auciello has edited 20 books and published about 500 articles in several fields, holds 20 patents, He is associate editor of APL and Integrated Ferroelectrics, He was President of the Materials Research Society (2013) Auciello is Fellow of AAAS and MRS

orlando.auciello@utdallas.edu

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