Crystallography of Titanium Oxides on the Implant Surface.

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The interface reactions between metallic implants and the various surrounding host tissues play a crucial role in the success of endosseous dental implants. Titanium is the ideal metal for dental implants, and it permits the natural formation of an oxide layer on its surface and thereby it prevents the release of potentially toxic molecules. Titanium has been shown to have a 41±18Å thick amorphous oxide, with a chemistry primarily of TiO_2. Titanium implants are covered by a surface oxide, which contributes to their high corrosion resistance and biocompatibility. The biocompatibility of titanium is largely due to the characteristics of its oxide layer. Strong adherence to the substrate, denseness and a quick self-healing capacity of the oxide film give titanium its corrosion resistance. TiO_2 also has a high dielectric constant, ranging from 50 to 170 depending on its crystal structure. A high dielectric constant results in considerably stronger van der Waals bonds on TiO_2 than on other oxides, which is believed to be important in the interface biochemistry. This type of protective film is called a passive film. TiO_2 is also catalytically active for a number of inorganic and organic chemical reactions.

The characteristic composition and structure of the oxide layer often differ depending on the technique used to prepare the surface of the metal. The exact composition of the oxide, TiOx, (where x is a number in the range 1.0 - 2.0), its morphology and texture (e.g., amorphous or crystalline, porous or dense), thickness, and content of low concentrations of impurity elements are examples of properties that may be varied in a controlled manner.

Much work has been done to identify the crystallography of titanium oxides formed on implant surface, but little is know about the optimal titanium oxides properties that promote tissue-implant interaction.

In this presentation, I will show the seven possible types of oxide formed on titanium surface and figure out the relation between biological response and crystallography of titanium oxides on the implant surface. In addition, I will present the related research that I am interested in.