

When Is Metal-Free Devoid of Metal?

If you ever wanted to step blindly into a controversial topic, this might be the one for you. It is a subject that makes it difficult to differentiate truth from fiction. I may be losing you, so let me get to the point. How many times do we see the description of metal-free restorations and then realize that the material used to make the metal-free restoration is a combination of metal and nonmetal?

The characteristics of metals are easy to identify. Metals are lustrous. They are good conductors of electricity and heat. Metals may be, and usually are, single elements that are found in the periodic table.

Up to this point there is nothing to disagree with, but as you read forward, perhaps you will rethink the topic. The situation becomes much more gray—the flat color, not the shiny one—as the topic switches to ceramics.

The reason for this is that ceramics have distinctly different defining features than the metals from which they are made. The classic description of a ceramic is that of a metallic oxide. Ceramics may be physically hard, although they are weak in tension or compression. They are poor conductors of electricity and tend to be thermal insulating materials. Ceramics are not single materials that are found on the periodic table. Generally, ceramics are materials that are combinations of elements that perform differently than the individual elements.

Of course, most of the materials that we live with are combinations of chemicals that do not act the same as the individual elements do. Sodium chloride is an excellent example. We certainly cannot ingest pure sodium or pure chlorine because either one would be toxic to us. However, table salt is a combination of sodium and chlorine, in the ionic form, which is ingested by virtually every human every day. The compound, sodium chloride, is not a metal, but it is made from a metal and a nonmetal.

So, taking this all with a grain of salt, how is it that a ceramic material can be thought of as a being metal-free while, without the metal, it ceases to exist?

Ceramic materials are often described as nonmetallic, and this is where the troubles start. The logic behind this description comes from the physical behavior of ceramic materials that does not mimic the constituent metals; of course, the same may be said for other chemical formulations as suggested above.


Those who describe ceramics as a metallic oxide often pose the question of what is left once the metal is removed. Subtract the metal from a ceramic and you are left with oxygen. Although the biologic benefits of oxygen are obvious, it alone will not support a dental prosthesis.

Perhaps the more critical question is to whom the metal-free description is directed. Usually, this description is given to a dental patient, often in the form of an informational advertisement. It seems that the ability to market dental materials is improved when metals are removed from the discussion. Consequently, the dental patient is told that their new implant or crown is made from a new material that has no metal in its formula.

Well, it does not take a scientist to appreciate the fact that the description obfuscates the truth. The material itself has existed since the earth began. There goes the description of a “new” material. Oh, I understand that new elements may be created through nuclear fusion, but, to the best of my knowledge, this is not applicable to dental ceramics.

What we have with zirconia is a ceramic material that is made from a metal but is not a functioning metal. Just as the elements of titanium or aluminum perform differently when oxidized, any of these materials may take on different physical characteristics depending upon the way in which the material is handled.

Getting back to the original question, when is metal-free devoid of metal? I guess the answer depends on a lot of chemistry and a little bit of perspective. If my patient asks me if their zirconia prosthesis has metal in it, they usually do not want a 30-minute lecture on metallurgy and why zirconia is a metal or not. My response will be as truthful and uncomplicated as possible. I will say that it is a metallic oxide that performs as a ceramic. As I say this, I watch their facial expression turn from inquisitive to exasperated as Ray Davies lyrics run through my head.



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