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IB Chemistry SL

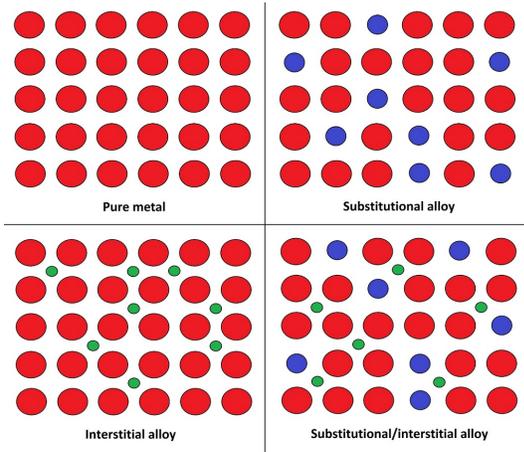
Alloy me to expand your knowledge of bronze

There was the Paleolithic age, there was the Neolithic age and then there was the Bronze Age. While the occurrence of these phases varies by geography, no one can deny the revolutionary effect that bronze had, and continues to have. One of the first metals known to man, the invention of the wheel, as well as many prehistoric weapons (including axes and daggers) can be attributed to the versatile alloy (“Bronze Age”). In fact, ancient history would look quite different had it not been for Bronze.

Bronze has a metallic structure whose bonding can be described as positive ions in a sea of delocalized electrons. Because of this reason, it has a high conductivity of heat, just like copper, which is metallically bonded to tin, creating the Bronze lattice structure. Surviving artifacts from the Bronze Age reveal that the proportion of copper in the alloy could be between 67 to 95% (Miller), the rest being tin, though the proportions of copper and tin in bronze vary. However, at times, smaller amounts of phosphor or silicone can be added to further enhance its properties.

These elements can find their way into the copper lattice through a variety of ways to form an alloy. The most common method for bronze is substitution. Like copper, bronze too, has a lattice structure and “tin atoms substitute directly into the [copper lattice] in

place of copper atoms” (“Metallurgy”). This can only take place if the atoms for each of the metals are roughly the same size. The figure below shows different arrangements for various alloys. The top right corner shows a substitution alloy, which resembles the



bronze lattice, the blue dots being tin atoms and the red being copper atoms.

Tin’s own unique properties when combined in the alloy, enhance the properties of ordinary copper. It’s atoms strain the copper lattice and increase the distance between copper atoms.

Zaereth. "Alloy Attachment Arrangements." *Wikipedia*. N.p., n.d. Web. 8 Feb. 2015.

This creates a stronger substance that is tough and ductile over a wide range of temperatures

and resistant to corrosion (“Bronze”).

These properties are especially important in construction, as corrosion in pipes and valves is dangerous; therefore, bronze is a wise material to use.

Unlike copper, bronze has a lower melting point (of 950 degrees), which results from its different physical properties (Helmenstine). This makes it a popular material for sculpture and also made it ideal for weapons in the past as imperfections could easily be fixed.

This is what makes bronze so fascinating.

## Source Evaluation

### **Copper Development Association: “Microstructures of Copper and Copper Alloys”**

The Copper Development Association (CDA) is a site that provides educational resources and statistics about copper in addition to articles and applications.

CDA is updated on a consistent basis, with articles as old as a few days displayed, demonstrating that it is sufficiently current. Because it is a developmental association, the site most likely finds its information through studies and experiments. This source is reliable and therefore acceptable for this assignment because it is a government-approved site. Therefore, it is dependable with comprehensive information on copper alloys.

### **About.com: “What is Bronze?”**

This particular source is an informative article explaining the properties of bronze, its historical context and definition. It is found on About.com, a site that provides various different educational articles on various topics. This particular article is written by Anne Marie Helmenstine, who has a doctorate in philosophy of biomedical sciences. She has taught chemistry, biology and physics at a college level and currently works as a science consultant. The article was last updated on the 4<sup>th</sup> of December, 2014 which was roughly two months ago, making it fairly reliable. There are no further references listed, so the reader can assume that the author has not used any sources. This article is particularly useful for this assignment because it references very basic knowledge and is useful to gain a small background around the topic. It is concise and provides the necessary information in a clear way that is easy to understand.

## Works Cited

- "Bronze | Alloy." *Encyclopedia Britannica Online*. Encyclopedia Britannica, 29 July 2013. Web. 07 Feb. 2015.
- Helmenstine, Anne Marie. "What Is Bronze?" *About Education*. About.com, 4 Dec. 2014. Web. 07 Feb. 2015.
- "Metallurgy of Copper-Base Alloys." *Copper Development Association Inc*. N.p., n.d. Web. 07 Feb. 2015.
- "Microstructures of Copper and Copper Alloys." *Copper Development Association Inc*. N.p., n.d. Web. 07 Feb. 2015.
- Miller, Augustus. "Material Properties of Bronze." *EHow*. Demand Media, 14 Apr. 2010. Web. 07 Feb. 2015.