Diffusion in Metals *

How is it possible to fuse metals at temperatures below their melting point?

Melting Point Melting point, also known as "liquidus," is the point where a material becomes fluid. At this point, the bonds between crystals have lost their ability to hold together, a bit like what happens when you move two magnets apart from each other. There comes a time when this gap is too large for the powers of attraction, and when this happens to a metal, the solid structure becomes fluid.

Diffusion Well before that point, the atoms of the metal are vibrating, and as the temperature rises, they vibrate more. When two materials that have similar properties are close together, the atoms will mingle and form a bond between the parts. That is called diffusion. In the case of PMC, when the microscopic particles of silver bump into each other, the edges merge and create a solid bond. In Aura 22 and keum-boo, the same kind of diffusion bond is happening between silver and gold.

Surface Surface area is a key factor. Surfaces are more active and have higher energy than the interior. That is why water evaporates from the surface. As you raise the temperature of a cup of water, it will evaporate faster and faster, but bear in mind that you don't have to boil the water to evaporate it. Similarly, as you raise the temperature of a solid (like silver), it has more heat energy. This increases the mobility of each particle, which allows it to move to a touching particle. This is called diffusion bonding.

Proximity Proximity, or the nearness of one part to another, is also very important in diffusion. Silver atoms vibrate, but not very far, so contact points are a key factor. More contact area means more diffusion sites. The key to all versions of metal clay are fine powders and the way they go together (called packing). The reason PMC3 fuses at a lower temperature than the other versions of PMC is because the very tiny particles are packed together tighter. Imagine a box of basketballs, then think of the points of contact and the relatively large spaces between the balls. That's a mental picture of Original PMC. Now think of tossing some tennis balls into the box and shaking it up. The tennis balls will drop into the spaces between the basketballs, significantly increasing the contact points. That's comparable to PMC+. Now take out the basketballs and toss in some marbles to fill the spaces between the tennis balls. The material is much denser and there are many more points of contact. That's PMC3.

* *This is a layperson's guide to advanced metallurgy, with apologies to the scientists who will recognize some over simplification.*