Keeping it Fake

Long before I reached the age of maturity, and certainly long before I thought it was a good idea to drink *anything* with a whole olive in it, I knew from watching James Bond movies that there were two ways to make a vodka martini. And although I have no direct memory of having done so at the time, I am almost certain that I annoyed my elders by ordering my lemonade shaken, not stirred.

Beyond the vodka and vermouth, the critical ingredient in preparing 007's favourite beverage is the ice, and even at that tender age, I knew that there were at least two distinct ways of making ice as well. Most ice we encounter has crystallized out of the liquid phase, a fancy way of saying it is frozen water. Snow and frost, on the other hand, are ice crystals that form by water molecules transitioning directly from the gas to the solid phase, a process known as *desublimation* or *deposition*.

Why the dipsomaniacal digression on the making of ice? Well, ice, like the gemstones we love, is a naturally occurring crystal. We choose to synthesize ice in large blocky forms in our refrigerators. Gemstones, it turns out, can also be synthesized in useful shapes by crystallization out of the liquid or gas phase, just like good old H_2O.

Crystallization from Liquid

By far the majority of synthetic gemstones are produced by crystallization in a liquid. This liquid can be the molten form of the solid material, just like the water in your ice cube tray. There is another way of crystallizing solid out of a liquid, however: *precipitation*. This is again a fancy way of saying a simple thing, which is "un-dissolving" something. If you ever made rock candy on a string suspended in sugar solution, you know exactly what I am talking about. There are three commercially viable ways of producing solid crystals from melted material and two ways of accomplishing precipitation from solution. Here's an overview:

Melt Processes

Flame Fusion is the oldest commercial technique for producing synthetic gemstones. Developed by Auguste Verneuil over a century ago (see "Musings on a Synthetic Ruby" opposite), flame fusion involves trickling finely powdered material through a hot hydrogen-oxygen flame in a sealed furnace. In Verneuil's original experiments, the powder was Alumina (Al_2O_3), in effect, powdered sapphire. Given appropriate conditions, the temperature in the flame can exceed 2200 °F (1200 C), sufficient to melt even the most refractory materials such as corundum. The droplets fall to the bottom of the apparatus, where they freeze, crystallize, and collect on an earthen or ceramic rod. Adding additional chemicals to the powder can produce an astonishing array of colours: for example, chromium dioxide added to alumina produces synthetic ruby (Figure 6-17), while adding titanium or iron oxides results in blue synthetic sapphire.

Common Flame Fusion synthetic gemstones: Ruby, Sapphire, Spinel

The **Czochralski Pulling** process arose from an industrial need for larger, stress-free crystals in the production of lasers. In this method, the raw material sits in a small container or crucible. Due to its high melting temperature and very low chemical reactivity, platinum is the