Gemstone Synthesis

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From antiquity, gemstones have been so very highly prized for their beauty and rarity that they have always been difficult and/or expensive to acquire. Therefore it seems only natural that people would try to mimic them with less costly, artificial materials, often with noble intentions, sometimes with not so noble intentions. In olden times, let us say before 1800, these artificial materials were mere substitutes or simulants of variable quality. It wasn't until the end of the 18th century, when the science of analytical chemistry was well developed, that people knew what elements and contaminants were needed to form the desirable stones. From then on the race was afoot to produce synthetic materials identical to the best, perfect, natural stones. These quests benefited science and technology in that the researchers had to develop/perfect and control means of producing and stabilizing very high temperatures, medium to very high pressures, and extremely pure starting materials.

In this colorful talk I will discuss many of the technologies used to produce true synthetic gemstones as well as simulants. I will follow a more or less chronological path to briefly cover the various techniques and the materials they create - such as:

Technique	**Synthetic or Simulated Material**
Flame fusion or Vernueil	ruby, sapphire(s), spinel(s)
Czochralski	ruby, sapphire(s), spinel(s), alexandrite
Flux growth	those above plus emerald
Hydrothermal	emerald, quartz
High P – High T	diamond
Skull melting	cubic zirconia
High temperature diffusion	moissanute
Chemical vapor deposition	diamond

Paul Hlava recently retired from Sandia National Laboratories in Albuquerque, New Mexico where he was staff member in charge of the electron microprobe laboratory. Paul worked on a wide variety of materials including alloys, welds, brazes, solders, ceramics, low-temperature superconductors, electronic materials, phosphors, nuclear waste simulants, thermal batteries, etc. Paul has written, co-authored, and/or presented over a hundred papers on a wide variety of materials. Paul graduated from the University of New Mexico with a geology MS in 1974. At UNM he worked as a research graduate doing probe research under Klaus Keil in the Institute of Meteoritics. He worked on moon rocks, Hawaiian basalts, ultramafic rocks, meteorites, and inclusions in diamonds and has been co-discoverer and co-author on the descriptions of several new mineral species. Paul has a business, Access to Gems and Minerals, Inc., dealing in gemstones, jewelry, and related items.