

# Gemstone Synthesis\*

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Efforts to synthesize gemstones were driven by the great desirability and extremely costliness of these objects. Original attempts to find inexpensive alternatives consisted of substituting easily obtainable materials for the “real” thing. This is partly due to economic factors, partly due to fraudulent intentions, and largely due to the general ignorance of the composition of gemstones and other materials. It wasn't until the end of the 18<sup>th</sup> century that chemistry, especially analytical chemistry, had developed to the point that researchers could determine the nature of the major, minor, and trace constituents of most of the known gemstones. From that time on dozens of researchers raced to reproduce true synthetics of each of the precious gems. As we shall see, advances in producing high-tech materials and simultaneously sustained high temperatures and pressures also came into play.

This talk will discuss some of the synthesis techniques by following, more or less, their development through time. Thus, after mentioning some early efforts, I shall discuss each technique used to mass produce synthetics. I'll start with the first and largest producer of synthetic gemstones - the flame fusion or Verneuil technique used to produce synthetic ruby, sapphires, and spinels. Then I'll mention the Czochralski pulling technique for the same gems. The quest for synthetic emeralds will introduce us to flux growth, flux-reaction, and hydrothermal techniques. The autoclave technique for quartz (amethyst, citrine, and smoky quartz) is a sub-set of hydrothermal. Diamonds require a discussion of high-pressure apparatus. Lastly, I will describe the skull melting technique for producing cubic zirconia.

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