**Crucible Steel – Bright Steel**

P T Craddock and J Lang

**ABSTRACT:** This paper describes the examination of two ferrous Islamic mirrors. One is of very pure iron but the other would appear to be of crucible steel, confirming contemporary descriptions that mirrors were of steel. The methods by which the steel could have been produced and the mirror fabricated are discussed. Recent work has shown that crucible steel was used for a wider range of artefacts than previously appreciated and its use for mirrors reflects another property of the metal that was utilised. Crucible steel as a bright material was certainly appreciated in 18th century Europe, when one of the first uses of crucible steel was as the source material for the imitation diamonds known as ‘brilliants’ that featured so much in costume jewellery of the period.

**Introduction**

Crucible steel is popularly regarded as essentially a product of the European Industrial Revolution of the 18th and 19th centuries (Barraclough 1984a and 1984b), used for items such as the superior clock and watch springs of Benjamin Huntsman (Wayman 2000) and the cannon of Frederick Krupp (Manchester 1969). There is also some perception that the distinctively-patterned damascus blades from India and the Islamic world were made from a crucible steel known as wootz that originated in India (Bronson 1986).

Recent researches, variously embracing archaeological, documentary and metallographic studies, have together shown that the production and usage of crucible steel was much wider and from a much earlier date than had been previously realised (Allan and Gilmour 2000; Anantharamu et al 1999; Craddock 1998 and 2003). This paper reports on the examination of a 14th century Islamic mirror (Fig 1) which metallographic analysis has shown is likely to be of crucible steel. This has documented another and very different property of the metal that was understood and valued in previous ages, namely the ability to take and retain a brilliant reflecting surface.

**Crucible Steel**

Iron has been a metal in very common use for the last three millennia throughout the Old World, and for most of that period it was produced by the so-called bloomery process in the solid state. The high melting point of iron (c 1540°C) made it difficult to produce as a liquid. Smelting and working iron in the solid state, however, meant that impurities from the smelting process were trapped in the metal as slag stringers, causing weakness and failure. Furthermore both pure iron and wrought iron, with its slag stringers, have inferior strength properties when compared to bronze (Smith 1967). It is only when iron contains a small proportion of carbon (typically 0.2 to 0.8%), to become steel, that the hardness and tensile strength exceed those of bronze. If it was possible to liquefy the steel, much improved properties would be achieved as the slag floats to the surface and could be skimmed off. Also more carbon readily dissolves in the molten steel and is distributed far more evenly than when it was introduced at the surfaces in the solid state. The steel was melted in highly refractory crucibles requiring skilled control of the components and the conditions because if too much carbon enters the metal, cast iron would be formed, which has completely different properties to steel.