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Porous Platinum Morphologies: Platinised, Sponge and Black

Platinum (as well as many other metals) may be prepared in finely divided forms that are porous at all levels of magnification. Cracks and crevices in the sponge-like opaque matrix then allow visible light (of wavelength around 0.5 μm) to enter, whereupon it undergoes multiple reflections and is unlikely to be reflected back out. This effectively produces a high value for optical absorption, resulting in a velvety black appearance to the eye, even though the platinum is in the metallic state. Other porous structures (such as snow and plaster) consist of inherently transparent or translucent crystals, so light can be refracted as well as reflected out and they appear matt white.

Three varieties of platinum in the porous state are generally recognised: 'platinised platinum', 'platinum sponge', and 'platinum black'. The first-named customarily signifies smooth metallic platinum bearing a black adherent coating that gives it a large surface area, enhancing reproducible contact between the metal and aqueous electrolytes. Platinised platinum may also exert a catalytic action, promoting recombination of hydrogen and oxygen, for example. The black coating is obtained by electroplating smooth, clean, metal foils in chloroplatinic acid solution. A deliberate trace of lead promotes adhesion to the substrate. A current density of about 5 mA cm^{-2} is typical, with polarity of the electrodes reversed every 30 seconds for 15 minutes.

'Platinum sponge' is a particulate form of the metal obtained by strongly heating ammonium chloroplatinate. This compound decomposes to leave platinum metal as the only involatile component. The particle size and degree of sintering appear to depend on temperature and other factors. Some preparations exhibit a grey rather than black appearance, and their catalytic activity varies. Platinum sponge was the form in which malleable iron-free platinum was first obtained by Wollaston (1–3).

'Platinum black' is an especially finely divided form of platinum, optimised for catalysing the addition of hydrogen to unsaturated organic compounds. Adams found that heating ammonium chloroplatinate in molten sodium nitrate at 500°C for 30 minutes was more effective than ignition in air (4). Pouring the molten mass into water, followed by boiling and washing, gave a muddy brown precipitate (said to be platinum dioxide) that could be concentrated by centrifugation. Reduction of the suspension in water with gaseous hydrogen then gave a black suspension going down to colloidal in particle size, i.e. 1 nm to 1 μm. Commercial preparations of platinum black (5) are available with guaranteed specific surface areas of 24.4 to 29.2 $m^2 g^{-1}$.

More details on these forms of platinum, together with scanning electron micrographs illustrating their structures, are available in Reference (6).

ALLAN MILLS

References

1 M. C. Usselman, *Platinum Metals Rev.*, 1978, **22**, (3), 100

2 D. McDonald and L. B. Hunt, "A History of Platinum and its Allied Metals", Johnson Matthey, London, 1982, 450 pp

3 Th. Rehren, *Platinum Metals Rev.*, 2006, **50**, (3), 120

4 L. B. Hunt, *Platinum Metals Rev.*, 1962, **6**, (4), 150

5 Johnson Matthey Catalysts, Platinum Black – High Surface Area, Datasheet, www.jmcatalysts.com/pct/search-msds-view.asp?productid=507

6 A. A. Mills, 'Platinized Platinum, Platinum Sponge and Platinum Black', *Bull. Sci. Instrum. Soc.*, 2006, (89), 35 and references therein

The Author

Dr Mills is an Associate Senior Lecturer in the Department of Physics and Astronomy at the University of Leicester, U.K. He continues a long-standing interest in the history of science and scientific instruments.