

A METHOD AND APPARATUS FOR FASTER AND REPRODUCIBLE PATINATION PROCESS FOR ALLOYS USED IN BIDRIWARE

IITM Technology Available for Licensing

Problem Statement

- Bidriware, the sleek and smooth **dark colored metalwork with intricate eye-catching designs on its glossy surface**, is famous all over the world.
- The **conventional patination process** (black/dark background), uses a mixture of ammonium chloride (NH₄Cl) and the clay taken from the surrounding of the Bidar fort wall. As the fort is now a **heritage center the use of sand is prohibited, making the livelihood of artisans difficult and threat for the art.**
- There is a need in the art for a viable chemical substitute, an **alternative procedure of the process** and an apparatus, which can provide faster, efficient way of patination.

Intellectual Property

- IITM IDF Ref. 1681
- IN 407564- Patent Granted

TRL (Technology Readiness Level)

TRL 4 Technology Validated in Lab

Technology Category/ Market

Category- Advance Material & Manufacturing

Industry Classification:

- **NIC (2008)- 2592-** Machining, treatment and coating of metals; **20224-** Manufacture of prepared pigments and other coloring matter of a kind used in the manufacture of paints or by artists or other painters;
- **Applications-** Material processing which includes Lasers, optical methods, LIBS analysis, additive manufacturing, welding and cutting

Market drivers: The handicrafts market in India achieved a size of US\$ 4,277.5 million in 2023 and is projected to reach US\$ 7,817.8 million by 2032, with a compound annual growth rate (CAGR) of 6.9% during the period

Research Lab

Prof. Dr.-Ing. Lakshman Neelakantan

Corrosion Engg. and Materials Electrochemistry Lab, IITM

Prof. Manas Mukherjee

Dept . of Metallurgical and Materials Engineering, IITM



Figure: Photograph showing the polished part of a specimen and the part subjected to patination upon exposure to the alternative chemical solution.

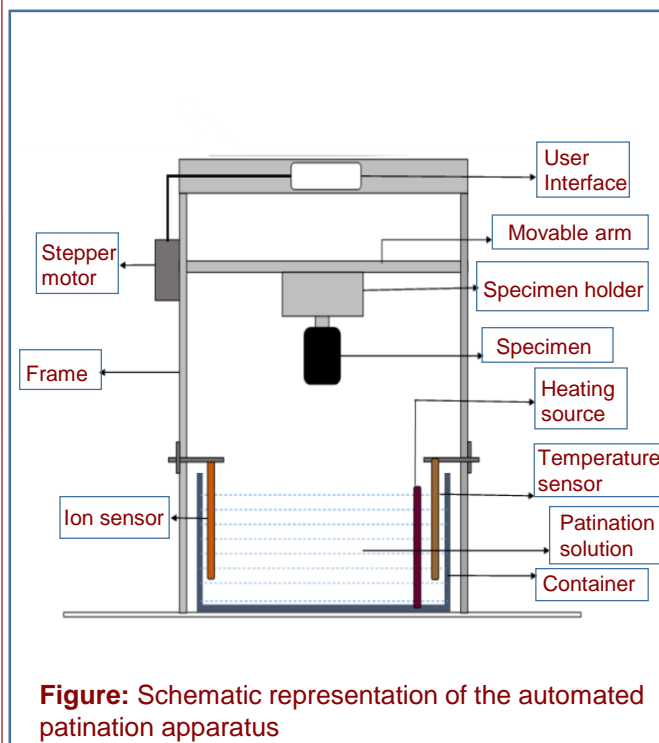


Figure: Schematic representation of the automated patination apparatus

CONTACT US

Dr. Dara Ajay, Head TTO
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
<https://ipm.icsr.in/ipm/>

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in

Phone: +91-44-2257 9756/ 9719

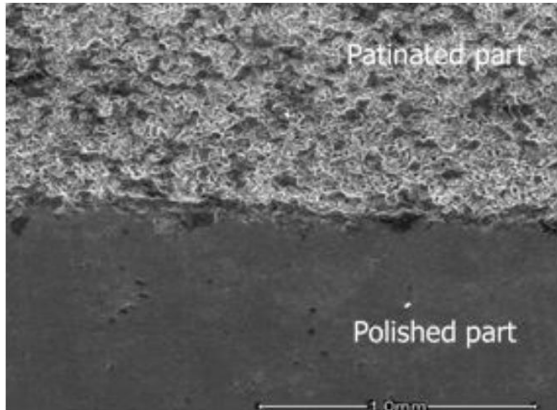


Figure: SEM micrograph reveals that reveals the surface morphology of the Zn-Cu alloy differentiating the un-patinated and the patinated surface

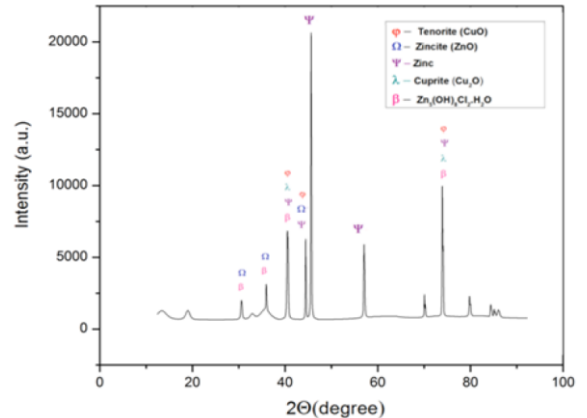


Figure: The X-ray diffraction analysis was carried out on the patina reveals signature peaks corresponding to CuO (Tenorite) and Cu₂O (Cuprite)

Technology



The patination process developed involves immersion of the Zn-Cu alloy in a solution containing NH₄Cl and alkali nitrates (K/Na/Ca-nitrates) in a certain ratio dissolved in water. The chemical solution is then heated to and maintained at 70 °C.



The specimen is immersed in the patination solution for a certain period of time. Upon exposure of the specimen to the patination solution, electrochemical dissolution of Zn/ or Zn rich phase occurs on the surface leading to the enrichment of Cu/Cu rich phase on the surface. This Cu enriched surface undergoes oxidation in the patination solution to form a black colored oxide (patina)



Zinc in the alloy preferentially dissolves into the solution leading to a Cu enriched surface, which then oxidizes to form the patina.



An apparatus has been conceptualized, designed and fabricated for automation of the patination process



The patinated surface was characterized using X-ray diffraction (XRD), Scanning electron microscope (SEM) and X-ray photoelectron spectroscopy (XPS)

Key Features / Value Proposition

- The process successfully imparts a black patina similar to the one observed in Bidri craft.
- The process developed completes the patination process within 20-30 seconds which is much faster compared to another recently patented process.
- The process uses easily available chemicals and a simple yet automated apparatus to carry out patination. This process would help in augmenting livelihoods of artisans and increase production of Bidriware by reducing dependence on unsustainably extracted soil from heritage structures.

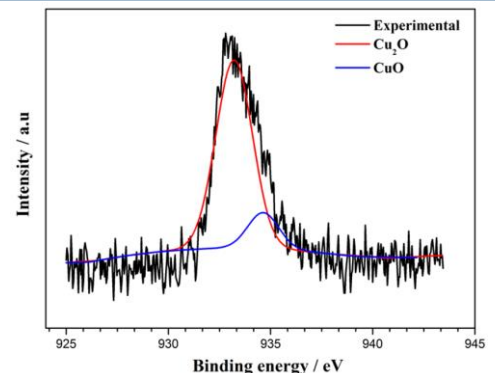


Figure: By comparing the ratio of the two peaks, one can conclude the oxide majorly comprises of Cu₂O (cuprite) along with CuO (tenorite).

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IITM TTO Website:
<https://ipm.icsr.in/ipm/>

Email: smipm-icsr@icsrpiis.iitm.ac.in

sm-marketing@imail.iitm.ac.in

Phone: +91-44-2257 9756/ 9719