

# Damascus Steel Khanjar

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## Introduction

Assumptions for reconstruction of the oriental Damascus Steel blade, on the basis of existing (18/19th century) specimen from National Museum in Cracow:

- to use traditional blacksmith techniques and modern scientific methods
- to manufacture a high carbon content wootz ingot, showing dendritic structure
- to modify microstructure by heat treatment
- to hand-forged a blade similar to museum-quality Damascus Steel blade shape, properties, micro- and macrostructure
- to analyze properties and microstructure of the final product

## Manufacturing the blade

-receiving the wootz ingot: Induction furnace melting process was employed. Graphite-clay crucible was used. As charge Armco iron with graphite and minor addition of carbide-forming materials was used. Slow cooling rate was provided.

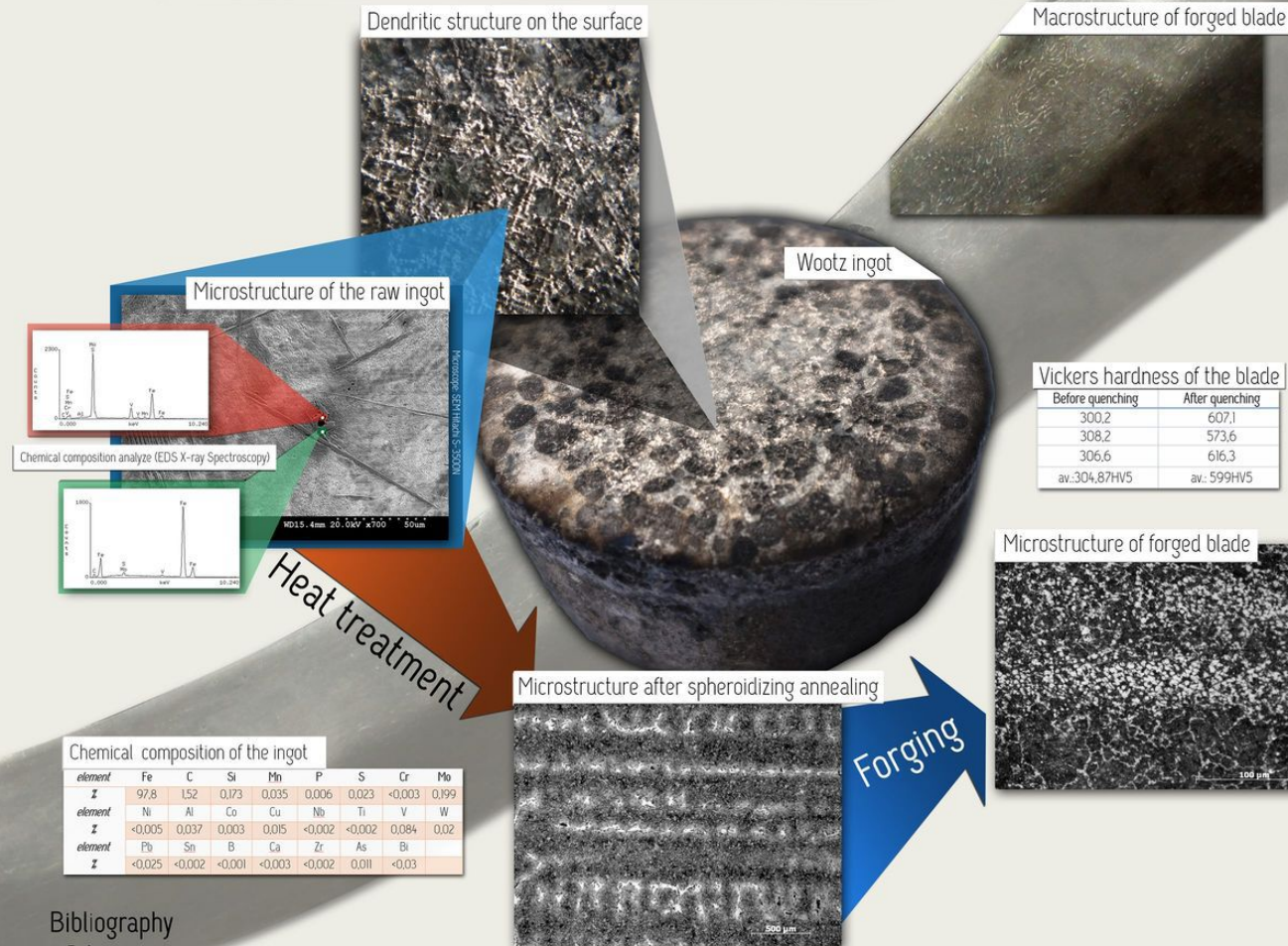
-heat treatment: Cycle spheroidizing annealing



-forging the blade: The blade was hand-forged in 850-650 Celsius degree range. 85 cycles of forging and heating were necessary.

-hardening: Water quenching in 50 °C above  $A_c1$  curve with high tempering

-finishing: Mechanical polishing and etching in sulfuric acid



## Conclusions

1. Microstructure of the manufactured blade matches microstructure of museum-quality wootz blades. [1]

2. Desired shape of the blade have been obtained.

3. Hot processing of the obtained ingot is possible after proper heat treatment and cause forming of visible Damascus pattern on the etched surface.

4. Melting conditions executed in induction furnace did not provided controlled carburization of an ingot. Although, received chemical composition still allowed to carry out further forging.

## Bibliography

References:

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