

## **Analysis of the possibility of gas boriding using unconventional boron source - organic compounds**

The main scientific objective of this project is analysis of the possibility of gas boriding using unconventional boron source, which will be non-toxic in comparison to the conventional boron halides ( $\text{BCl}_3$ ,  $\text{BF}_3$ ). The problem of use the typical boron source in gas boriding process is related to toxic character of these agents. In this project the applying of organic compounds is planned in order to produce the borided layers on Armco iron substrate.

The main objectives of this project are as follows:

- The choosing of organic compounds, which can be good candidate for gas boriding;
- The modification of gas boriding devices, which was applying to the gas boriding in  $\text{N}_2\text{-H}_2\text{-BCl}_3$  atmosphere;
- The gas boriding using organic compounds (the first one, which has already been selected is triethyl borane) and gaseous atmosphere (for example  $\text{N}_2\text{-H}_2$  or  $\text{N}_2$ );
- Analysis of growth of borided layer on Armco iron substrate dependent on boriding process condition (temperature, time);
- After analysis of results of gas boriding, the selection of the organic compounds, which will be the most suitable for gas boriding process.

The gas boriding process of Armco iron and steels using boron halides is good known. This process is appropriate method to form thick layer on Armco Iron or steel substrate. Unfortunately,  $\text{BCl}_3$  as a boron source is considered as a very toxic, dangerous, relatively expensive and explosive substance. Moreover the strong corrosive occurred in the chamber as a result of use of boron trichloride. Therefore the use of boron trichloride as a boron source in gas boriding process is limited. In this project the boron trichloride will be eliminated as a boron source, and the aim of this project is choosing of unconventional boron source. The possibility of use organic compounds as a boron source in plasma assisted process was the inspiration to analyze the possibility of applying these sources in gas boriding process. However there is no literature data about gas boriding in organic compounds, therefore this project is pioneering in respect of unconventional boron source in gas boriding method.

The project can influenced on development of gas boriding technique. Gas boriding process in  $\text{H}_2\text{-BCl}_3$  atmosphere or  $\text{N}_2\text{-H}_2\text{-BCl}_3$  atmosphere cannot be used in industrial application because of the toxicity of boron trichloride. The search for alternative sources of boron is very important aspect in development of gaseous method of boriding. Therefore the objectives of this project is analysis of the possibility of gas boriding using unconventional boron source, which will be non-toxic in comparison to the conventional boron halides ( $\text{BCl}_3$ ,  $\text{BF}_3$ ).

General investigation work plan includes:

- Selection of organic compounds which can be used for gas boriding;
- Selection of gas boronizing parameters;
- Gas boriding under different process conditions (time, temperature, boron source, gas flow rate, continuous process, two-stage process);
- Formation of boride layers on Armco iron substrate;
- Analysis of microstructure of boride layers (OM, SEM, phase analysis).
- Measurements of borided layer thickness and analysis of growth of layer dependent on boriding conditions;
- Determination of microhardness of borided layer and wear resistance of produced layers.