

# *Industrial Application of Thixomet Image Analyzer for Quantitative Description of Steel and Alloy's Microstructure*

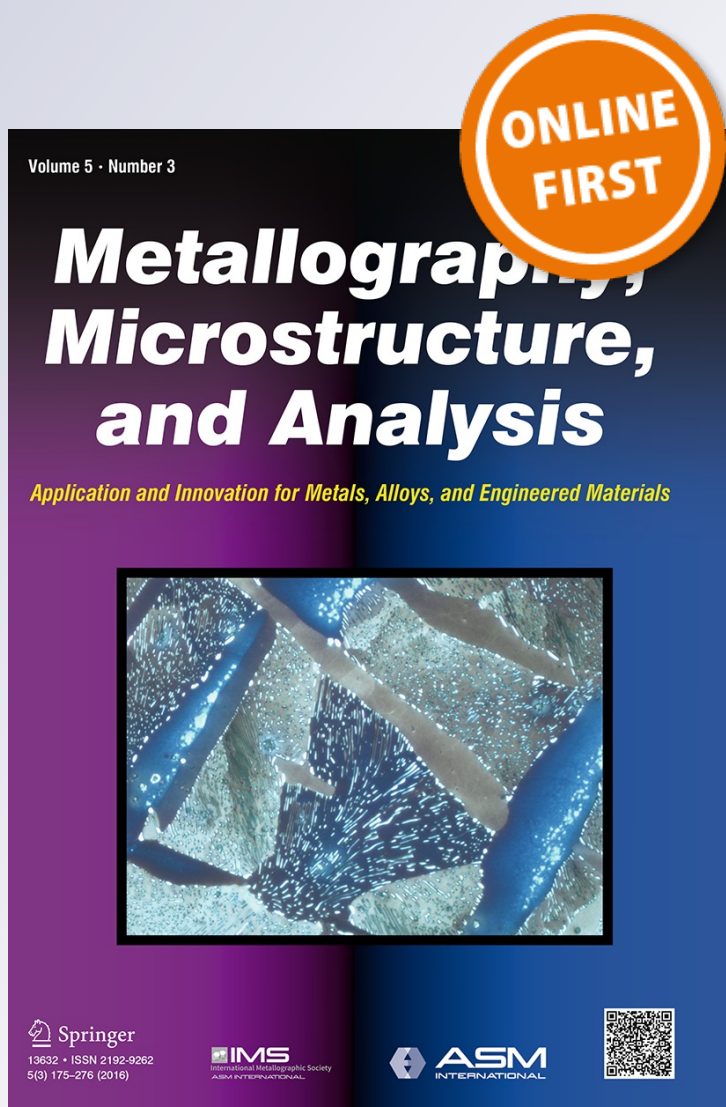
**Alexander A. Kazakov & Daniil Kiselev**

## **Metallography, Microstructure, and Analysis**

Application and Innovation for Metals, Alloys, and Engineered Materials

ISSN 2192-9262

Metallogr. Microstruct. Anal.  
DOI 10.1007/s13632-016-0289-6



# Industrial Application of Thixomet Image Analyzer for Quantitative Description of Steel and Alloy's Microstructure

 Alexander A. Kazakov<sup>1</sup> · Daniil Kiselev<sup>2</sup>

 Received: 20 January 2016/Revised: 21 April 2016/Accepted: 25 May 2016  
 © Springer Science+Business Media New York and ASM International 2016

**Abstract** Numerous examples of practical use in industry of the Thixomet image analyzer for quantitative description of the microstructure of steels and alloys have been described. More than 200 image analyzers have been installed at Universities, R&D labs, and plants during the twenty years of the Thixomet's history. Sixty-five Thixomet plug-ins cover all Russian and most of International standards. The techniques of quantitative description of non-metallic inclusions, grain size, and all kinds of microstructural inhomogeneity in modern pipeline steels (such as microstructure banding, general anisotropy, blocks of a bainite with lath morphology, centerline segregation) have been developed, realized, and put into practice as a motorized hardware–software complex, Thixomet SmartDrive, at many enterprises. It was established that structural inhomogeneity evaluated by volume fraction and a blocks length of a bainite with lath morphology elongated along the rolling direction adequately described the mechanical properties of pipeline steels. The name of Thixomet was taken because of Greek “Thixis” (touch) and “Metrisi” (measurement), so an idea is “One Touch Measurement.” Measurement operations from capturing an image up to a generation of quantitative description of a structure as a report are actually performed by several

evident actions that confirm the name of the product. Thixomet has succeeded in international interlaboratory Round Robin Test Programs and performed with the good results across worldwide Image Analysis systems. This was a cause to get an official metrological certificate from Russian State Metrological Committee which certified Thixomet as a measurement tool.

**Keywords** Steel and alloys · Microstructure · Image analyzer · Microstructural inhomogeneity · Pipeline steels · Structure–property relationships

## Quantification of Semi-Solid Materials (SSM) Structure

In 1996, the very first Thixomet image analyzer unit was installed at the Alumax Technical Center (Golden, CO) for the quantification of semi-solid materials structure based on the A356 alloy. Along with an evaluation of porosity distribution, eutectic content (continuous and occluded) and silicon content across the billet's diameter, a special grain shape factor was calculated in studies of anodized specimens examined in polarized light [1]. An identification and integration of dendrite fragments, revealed in a planar image, into one structurally isolated object was possible as a result of this measurement (Fig. 1). So, this shape factor of thixotropic grains can be evaluated taking into account the structural connections between its fragments. In this approach, a total specific length of interfacial boundaries is a function of the number of identified structurally isolated objects in 3D and not to the overall number of grains revealed in the 2D field of view. The grains are grouped based on the principle of their identical crystallographic orientation fixed by the common color of

This article is an invited paper selected from presentations at the 2015 Microscopy & Microanalysis Conference, held August 2–6, 2015, in Portland, Oregon, USA, and has been expanded from the original presentation.

✉ Alexander A. Kazakov  
kazakov@thixomet.ru

<sup>1</sup> Peter the Great St.Petersburg Polytechnical University, St.Petersburg, Russian Federation

<sup>2</sup> Thixomet LTD, St.Petersburg, Russian Federation