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Method and requirements for plasma nitriding and follow-up PVD hard coatings on cold-work mould steels

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 9, *Physical vapor deposition coatings*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Cold-work moulds in automotive application are subjected to heavy wear and severe pressures, while meeting key criteria including high surface hardness and good core strength. Due to higher hardness and better wear resistance compared with the physical vapour deposition (PVD) coating, the duplex treatment based on plasma nitriding and follow-up PVD hard coating has been widely used to improve the lifetime of cold-work moulds in the automotive industry. Plasma nitriding is contributed to improve the loading capacity of the substrate prior to PVD coating deposition. It prevents the plastic deformation of the substrate and delamination of thin and brittle coating, and provides proper stress and hardness gradients between the coating and the substrate, which contributes considerably to the increase in performance of the PVD coating. However, there is no standard to qualify the process, specification and quality of the duplex treatment, which hinders the further development of duplex PVD coatings in the cold-work moulds.

Method and requirements for plasma nitriding and follow-up PVD hard coatings on cold-work mould steels

1 Scope

This document specifies a method and requirements for plasma nitriding and follow-up PVD hard coatings intended for use in cold-work moulds. This document provides the necessary information, such as the original structure of nitriding steels, process requirements, surface quality and adhesion of duplex PVD coatings, to create an optimal combination of high performance.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method*

ISO 27831-1, *Metallic and other inorganic coatings — Cleaning and preparation of metal surfaces — Part 1: Ferrous metals and alloys*

ISO 18203, *Steel — Determination of the thickness of surface-hardened layers*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
adhesion
amount of energy required to separate the coating from the substrate, that ensures the coating remains adhered to the surface for long especially under aggressive conditions

4 Requirements of cold-work mould steels

The alloying elements in cold-work mould steels, such as chromium, vanadium, aluminium, tungsten and molybdenum, are beneficial in plasma nitriding because they can form stable nitrides at nitriding temperatures.

For different service conditions, cold-work mould steels are subjected to conventional heat treatment such as thermal refining by quenching and tempering prior to plasma nitriding. The specimen should be made of cold-work mould steels with a hardness of HRC45 to HRC60. Rockwell hardness test shall conform to the requirements of ISO 6508-1. The test piece for the structure and properties evaluation shall be treated in the same batch as the moulds. The original structure is observed and evaluated by the optical microscope when magnified 500 times. Classes 1 to 5 are specified in Table 1. The schematic drawings of original structures are shown in Figure 1. Classes 1 and 2 reveal acceptable structures.