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Effect of bias on TiN coatings prepared by vacuum arc deposition

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TiN thin films were prepared on high-speed steel substrates by arc ion plating with both dc and pulsed biases. A thermocouple was used to measure the substrate temperature during deposition. The results showed that the substrate temperature was decreased evidently when pulsed bias instead of dc one was employed, which is one of the conditions for the low-temperature deposition of hard coatings by using vacuum arc. The morphology and the microstructures, observed by scanning electron microscopy and transition electron microscopy, respectively, were also improved when dc bias was replaced by pulsed bias. The experimental results of morphology can be well explained by a simple established model, which is based on a viewpoint of vacuum plasma, but needs further study and confirmation. The properties of the films were also examined in terms of micro-hardness, adhesive strength and friction coefficient. It was found that these mechanical properties were better in case of pulsed bias than dc bias. It is concluded that pulsed bias can be used not only to lower the substrate temperature but also to improve the properties of TiN films, so that the low-temperature deposition of hard coatings can be realized.