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INVESTIGATION OF DIFFUSION PHENOMENA IN THE CONTACT AREA BETWEEN STEEL AND VARIOUS PVD COATINGS BY A DEVELOPED EXPERIMENTAL SETUP

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Experiments of diffusion phenomena at elevated temperatures between $Ti_{35}Al_{65}N$, $Ti_{46}Al_{54}N$ and TiAlN/TiSiN PVD coated cemented carbide inserts and counterparts of 42CrMo4 steel were conducted by a convenient device, developed for this application. The coated specimens were further investigated for providing insight in the effects of diffusion on the mechanical properties of the used coatings.
The coated specimens were fastened inside an electrical heating unit allowing their contact with steel counterparts of appropriate geometry at constant temperatures, in the range of 600 up to 800°C. The contact pressure between the coated specimens and the steel counterparts can be adjusted at desirable levels. The entire procedure is supervised by appropriately developed computer software. During the conducted tests, the temperature was monitored at various locations of the developed experimental setup and adjusted by PID controllers. A pressure of 0.1 MPa was applied between the specimen and the counterpart once the desired temperature value was reached, to avoid the plastic deformation of the counterparts. During the experiments, periodic intervals of pressure were followed by brief no-contact pauses, to eliminate any permanent welding between the coating and counterpart. The ratio of contact time to no-contact pause is adjustable. The experiments were performed in a sealed inert-gas atmosphere, in order to avoid oxidation developed at high temperatures. By means of Scanning Electron Microscopy, content percentages of various elements on the surface of the cutting insert and counterpart were measured. In this way, the percentile concentration of the steel elements into the coating and the speed of the diffusion process were assessed.
Finally, nanoindentations were performed on the contact area of the coating to the counterpart and the attained results were evaluated for determining potential mechanical properties changes induced by the diffusion processes. These were attained by FEM analyses of the nanoindentation results.

Keywords
PVD coatings
diffusion
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