# Ultra-smooth combined polishing process for nic kel-phosphorus alloy components

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*As a metal coating material commonly used in optical components, nickel-phosphorus alloy has excellent machinability, wear and corrosion resistance, and is widely used in extreme ultraviolet optical systems such as X-ray mirrors. Single point diamond turning is the most typical processing method of nickel-phosphorus alloy, but it will leave periodic marks, which lead to poor roughness. So ultra-smooth polishing is necessary. In this paper, the ultra-smooth polishing process of nickel-phosphorus alloy is studied in detail. By combining two polishing methods, magnetorheological polishing(MRP) and small tool polishing, the full-frequency error convergence of nickel-phosphorus alloy can be realized efficiently. Firstly, the polishing effects of single process of magnetorheological polishing, small tool polishing and ion beam polishing on nickel-phosphorus alloy were studied respectively. Then, the effects of different proc2essing parameters of magnetorheological polishing and small tool polishing on the polishing effect of nickel-phosphorus alloy were studied by orthogonal experiments, and the optimal parameter combination was found. Finally, a nickel-phosphorus plane with a diameter of 50mm was processed by the combined polishing process chain. The low-frequency surface error of RMS 3.1nm, mid-frequency roughness of Sq 0.3nm and high-frequency roughness of Sq 0.2nm were achieved, and the cumulative polishing time was just 56min.The method of magnetorheological polishing and small tool polishing combination proposed in this paper uses magnetorheological polishing to quickly remove the turning marks and reduce the low, medium and high frequency errors, and then uses the small tool polishing to refine the medium frequency roughness slightly and improve the high frequency roughness significantly while retaining the low frequency surface profile, and at the same time realize the cleaning of the nanoscale hydroxy-iron powder left by magnetorheological polishing. The experimental results show that this method has strong feasibility, the processing effect is much better than that of single polishing method, and the optional route of ultra-smooth polishing of ultra-ultraviolet optical components is widened.*