

पेटेंट कार्यालय
शासकीय जर्नल

**OFFICIAL JOURNAL
OF
THE PATENT OFFICE**

निर्गमन सं. 19/2024
ISSUE NO. 19/2024

शुक्रवार
FRIDAY

दिनांक: 10/05/2024
DATE: 10/05/2024

पेटेंट कार्यालय का एक प्रकाशन
PUBLICATION OF THE PATENT OFFICE

(12) PATENT APPLICATION PUBLICATION

(21) Application No.202441034510 A

(19) INDIA

(22) Date of filing of Application :01/05/2024

(43) Publication Date : 10/05/2024

(54) Title of the invention : HIERARCHICAL NANOSTRUCTURE ALLOYS FOR ANISOTROPIC MECHANICAL PROPERTIES IN HIGH-PERFORMANCE COMPONENTS

(51) International classification :C22C0001040000, B82Y0030000000, B82Y0040000000, C22C0032000000, C30B0029600000

(86) International Application No :NA
Filing Date :NA

(87) International Publication No : NA

(61) Patent of Addition to Application Number :NA
Filing Date :NA

(62) Divisional to Application Number :NA
Filing Date :NA

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(57) Abstract :
 HIERARCHICAL NANOSTRUCTURE ALLOYS FOR ANISOTROPIC MECHANICAL PROPERTIES IN HIGH-PERFORMANCE COMPONENTS ABSTRACT The hierarchical nanostructure alloy (HNA) presented herein revolutionizes anisotropic mechanical properties in high-performance components. Comprising a base alloy matrix with a predetermined composition—encompassing titanium (Ti), aluminum (Al), nickel (Ni), or their alloys—and a multitude of nanostructures exhibiting hierarchical arrangements at various length scales, the HNA achieves unprecedented mechanical characteristics. These nanostructures, including nanoparticles and nanowires composed of carbides, nitrides, oxides, or intermetallic compounds, synergistically contribute to the alloy's versatility and superior performance. The manufacturing process involves preparing a melt of the base alloy matrix, introducing nanostructures to form a mixture, and solidifying it, ensuring the creation of a high-performance alloy with tailored anisotropic mechanical properties. This innovation not only provides adaptability in alloy composition but also offers a scalable production method, promising transformative applications in aerospace, automotive, medical, and sporting components where precise and customizable mechanical attributes are paramount.

No. of Pages : 16 No. of Claims : 8