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现代应用光学

纳米磁微粒的双扫描干涉激光散斑实验

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摘要： 设计了研究纳米尺度磁微粒簇运动的双扫描干涉激光散斑实验。采用干涉条纹作为散斑运动的标度测量了磁流体中磁微粒的运动,避免了用传统数字散斑相干方法计算量大、精度依赖亚像素搜索算法的缺点;利用位相延迟扫描补偿横向扫描附加位相带来的干涉条纹变动,提高了动态散斑测量的空间分辨能力。对尺度为30～100 nm的磁微粒簇运动进行了实验分析,结果表明,受磁流体磁场变化的非线性、微粒间的碰撞和聚集等复杂因素的影响,磁微粒簇是以湍流,非匀速方式运动的,其运动的平均速度为6.93 mm/s。另外,该方法可通过改变条纹间距方便地调节精度以满足不同的测量要求。

关键词： 激光散斑 磁流体 干涉条纹 相位延迟扫描

Interferometric experiment of dual-scan laser speckle to characterize nano-magnetic particles

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Abstract: A double scanning laser speckle interrferometric experiment was designed to investigate the movement of nano magnetic particle clusters around 100 nm. In experiments, the interferometric fringes were used as the scales of speckle motion to measure the movement of nano magnetic particles in a magnetic flow field to avoid large computation and the precision dependent on the subpixel searching algorithm. Furthermore, the phase delay scanning was used to compensate the additional phase change caused by a transverse scanning to improve the space resolution of dynamic spackle measurement. An experiment was performed on the nano magnetic clusters with the sizes of 30-100 μm. The experimental results show that the movement of the magnetic particles in the cluster is nonuniform motion and a turbulent flow with an average speed of 6.93 mm/s, which are caused by the nonlinear changes of magnetic field, the collision and aggregation between the particles, and some unknown complex factors.Moreover, the method can meet the different measuring requirements for easy precision adjustment by changing fringe spaces.

Keywords: laser speckle magnetic fluid interference fringe phase delay scanning

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