

6. 光ピンセットの応用

浮田 宏生

6.1 光ピンセットの方法と対象

ベル研のアシキン (Ashkin) は、光を集光照射して透明な微小球を光トラップすることに成功した⁽¹⁾。この技術は、さっそく、生物学や医療の分野で生体細胞の非接触操作や細胞融合⁽²⁾に用いられるようになった。その後マイクロ化学の分野では反応物質の輸送⁽³⁾、機械の分野では微粒子の配列、微小物体の回転^(4,5)などに用いられ、応用が急速に広がっている (表参照)。

対象は固体でも液体でも細胞でもよい。光ファイバーによる操作も可能である。トラップ力は pN/mW 程度である。重力や浮力は粒径の3乗に比例して増大し、熱運動は粒径に反比例して減少するので、その中間に光ピンセットしやすい寸法がある (数 μm 程度)。

6.2 基礎科学分野での応用

6.3 産業分野での応用

Fields	Applications
Basic research	1. Physics: Measurement of optical pressure (1964) (6) 2. Biology: Measurement of swimming velocity of bacteria (1987) 3. Biology: Measurement of compliance of bacterial flagella (1989) 4. Chemistry: Microchemical conversion system (1994) (3) 5. Biology: Kinesin stepping with 8 nm (1993) 6. Mechanics: Measurement of particle rotation rate (1995) 7. Mechanics: Measurement of the drag force on a bead (1995) 8. Physics: Optically trapped gold particle near-field probe (1997) 9. Biology: Single molecule observation (1998) (7) 10. Biology: A trapped nanoparticles listen in ... (2012) (8)
Industry	1. Space engineering: Solar sail flight [http://planetary.org] (10) 2. Applied optics: Particle transport (1986) (1) 3. Biological engineering: Living cell fusion (1991) (2) 4. Mechanical engineering: 3-D microfabrication (1992) 5. Mechanical engineering: Shuttlecock optical rotor (1994) (4) 6. Applied optics: Optical fiber trapping (1995), (1999) 7. Mechanical engineering: Optical rotor with slopes (2003) (5) 8. Applied optics: Optically induced angular alignment (1999) 9. Mechanical engineering: Gear type optical rotor (2001) 10. Applied optics: Optical mixer (2002), (2004) (9) 11. Chemistry: Patterning surfaces with nanoparticles (2002) 12. Applied optics: Microstructure formation and control (2004)

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