

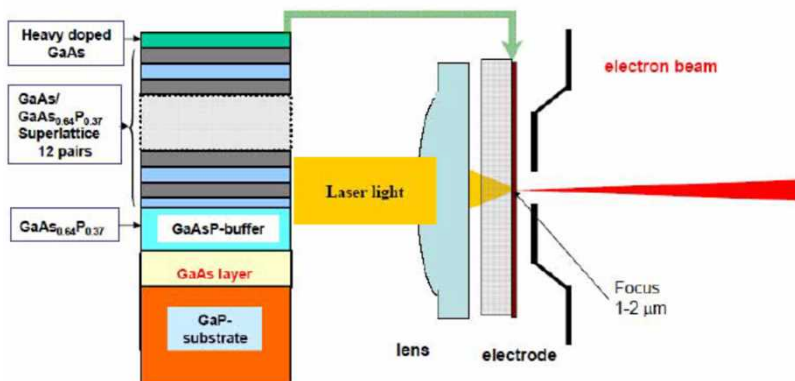
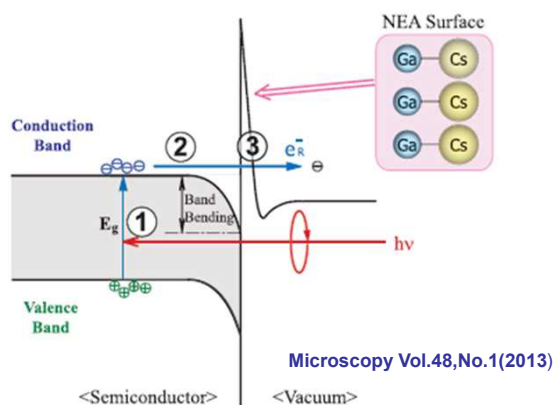
Spin-Polarized Electron Source and the Applications

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1. Abstract

Highly spin-polarized electron source with strained superlattice photocathode has been developed. It can provide high beam brightness and high energy resolution due to the narrow energy spread. Since the electron spin direction and temporal structure are controllable, various kinds of electron microscopes such as transmission electron microscope has been constructed.

2. Principle of the Invention



Spin-polarized electron source with GaAs/GaAsP strained superlattice photocathodes

Generation process of spin-polarized electron

- ① In the strained superlattice layer, spin-polarized electrons are excited to the conduction band due to a spin-selective excitation rule by illuminating circularly polarized light.
- ② The polarized electrons in the conduction band drift to the surface region.
- ③ The electrons extract into vacuum through an NEA surface with applying a negative electrostatic field. (NEA: Negative Electron Affinity)

3. Comparison of Brightness in various sources

Beam Brightness(A m⁻²sr⁻¹V⁻¹)

Polarized electron beam source

~10⁷ Transmission light absorption type electron source (GaAs-GaAsP SL)
 ΔE (energy linewidth): <0.3eV
 ΔI (current stability /1hour): < several %

~10⁴ Conventional SPLEEM (GaAs)
 ΔE (energy linewidth): <0.3eV
 ΔI (current stability /1hour): < several %

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~10⁸ Cold field emission source (W)
 ΔE (energy linewidth): 0.3eV
 ΔI (current stability /1hour): > 10 %

~10⁸ Thermal field emission source(W/ZrO)
 ΔE (energy linewidth): 0.7 ~ 1 eV
 ΔI (current stability /1hour): < 1 %

~10⁶ Thermal electron source (LaB₆)
 ΔE (energy linewidth): 2 ~ 3 eV
 ΔI (current stability /1hour): < 2 %

~10⁵ Thermal electron source (W)
 ΔE (energy linewidth): 3 ~ 4 eV
 ΔI (current stability /1hour): < 1 %

Non-Polarized electron beam source

Other Applications:

Measurement & Analytical Instruments: SEM, AES, EPMA,
Electron Beam Lithography

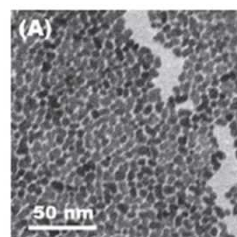
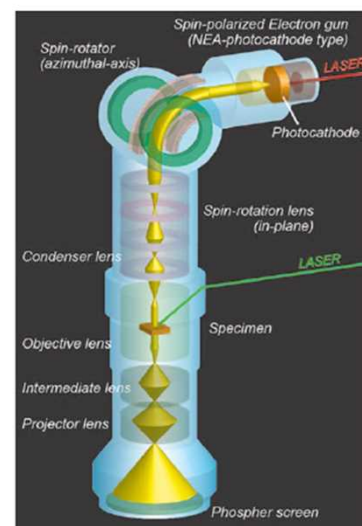
Patent Licensing Available

Patent : WO2011/122171 (JP, US, EP), US 8841615

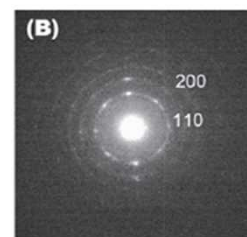
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4. Application Examples

Spin-Polarized Transmission Electron Microscope



TEM image of iron



Diffraction pattern
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