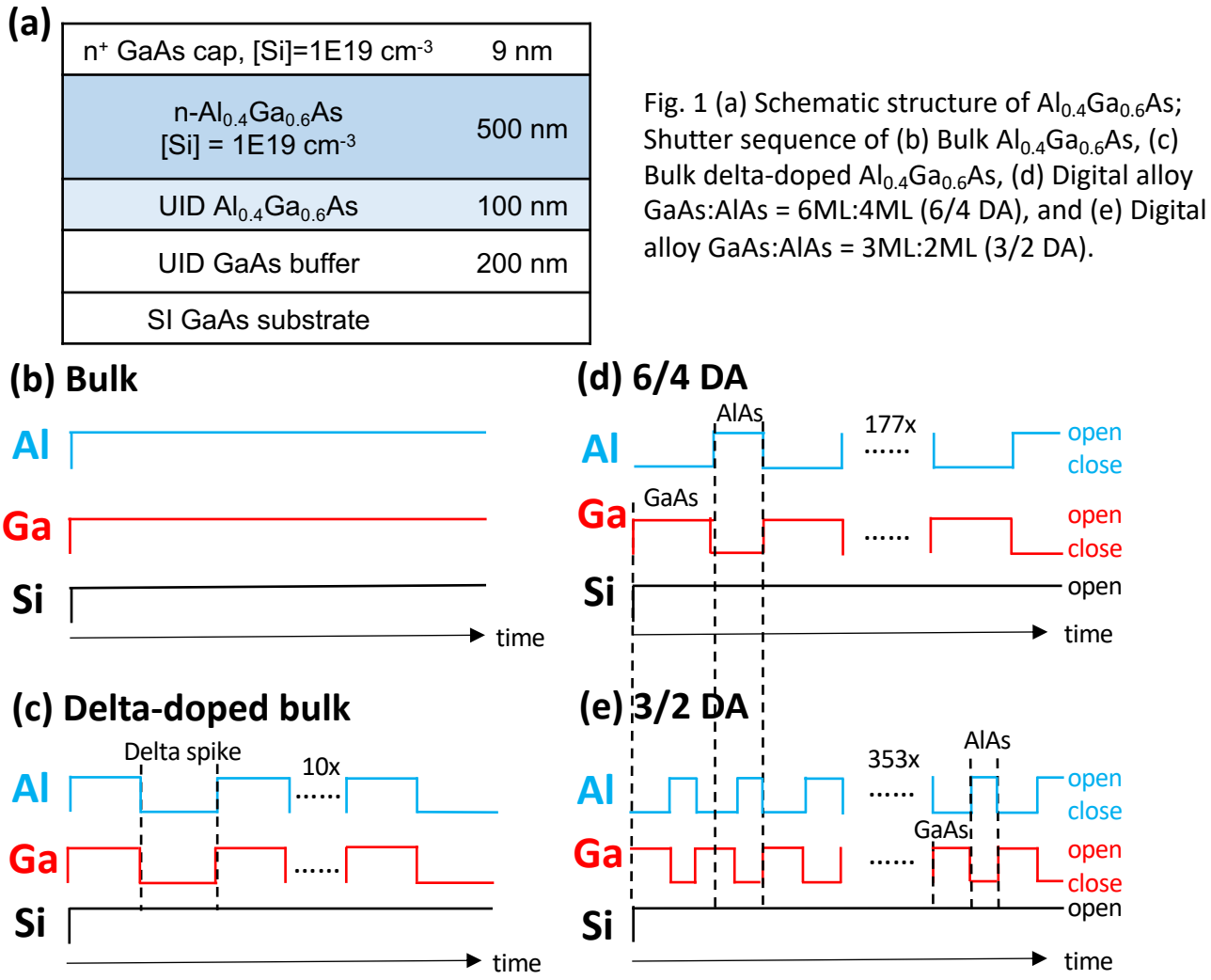


Fig. 1 (a) Schematic structure of $Al_{0.4}Ga_{0.6}As$; Shutter sequence of (b) Bulk $Al_{0.4}Ga_{0.6}As$, (c) Bulk delta-doped $Al_{0.4}Ga_{0.6}As$, (d) Digital alloy GaAs:AlAs = 6ML:4ML (6/4 DA), and (e) Digital alloy GaAs:AlAs = 3ML:2ML (3/2 DA).

| Growth Method | $n_0$ ($cm^{-3}$) | Doping enhancement over bulk alloy | Activation (%) | $T_{sub}$ (°C) | $T_{Si}$ (°C) | RMS (nm) |
|---|---|---|---|---|---|---|
| Bulk Alloy | 7.3E15 | 1 | 0.073 | 610 | 1223 | 2.1 |
| Delta doped | 1.0E16 | 1.4 | 0.10 | 610 | 1191 | 4.0 |
| 6/4 DA | 1.9E16 | 2.6 | 0.19 | 610 | 1223 | 1.0 |
| 3/2 DA | 1.0E17 | 14 | 1.0 | 500 | 1219 | / |
| 3/2 DA | 2.5E17 | 34 | 2.5 | 610 | 1223 | 1.4 |

Table 1. Description of bulk, delta-doped, and DA samples in this work. Activation = bulk doping/target doping = bulk doping/1E19 $cm^{-3}$.

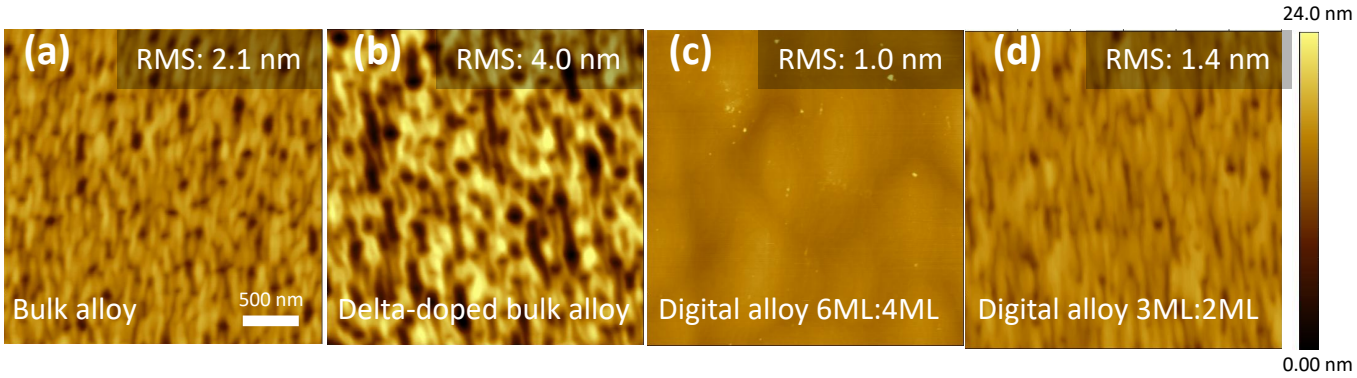


Fig. 2 AFM of n-$Al_{0.4}Ga_{0.6}As$:Si (a) Bulk alloy, (b) delta-doped bulk alloy, (c) 6/4 DA, and (d) 3/2 DA. The same scale bars apply to all figures.

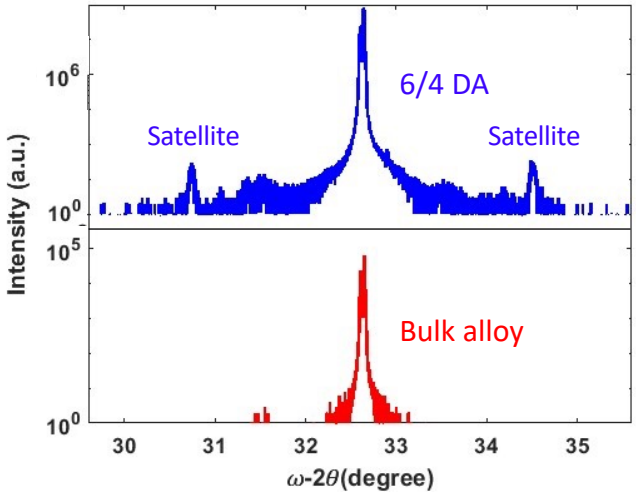


Fig. 3 004 $\omega/2\theta$ scans of n-$Al_{0.4}Ga_{0.6}As$:Si grown as bulk alloy (red) and 6/4 DA (blue). Satellite peaks of digital alloy match calculated positions for 10 ML periodicity.

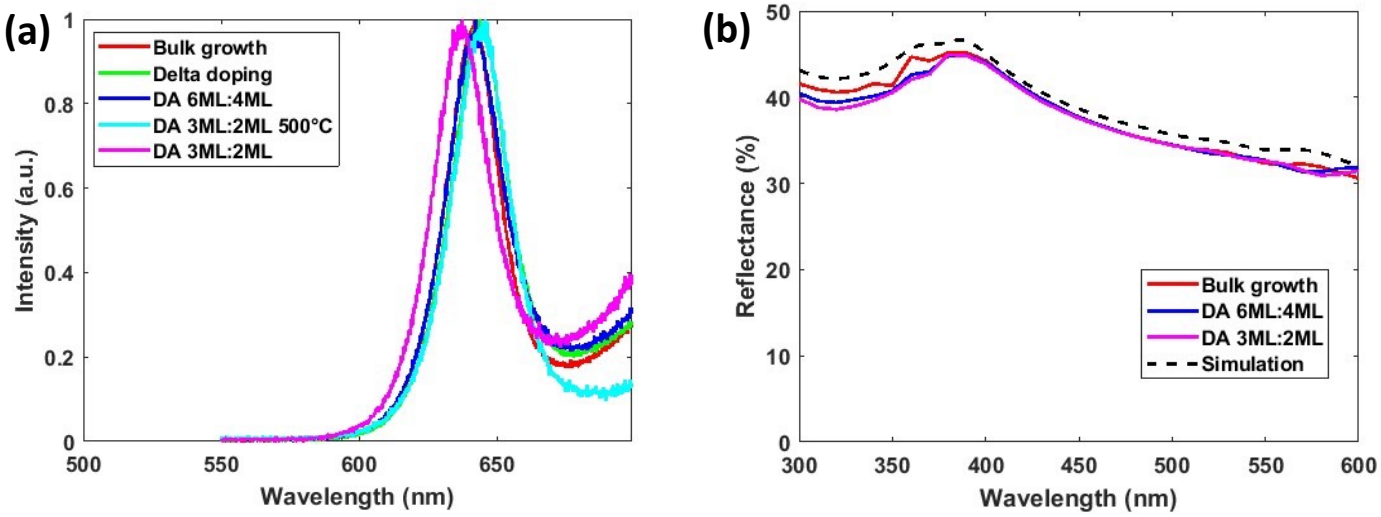


Fig. 4 (a) Micro-photoluminescence spectra of n-$Al_{0.4}Ga_{0.6}As$:Si samples showing only slight differences in emission wavelength. (b) Reflectance spectra of n-$Al_{0.4}Ga_{0.6}As$:Si samples in this work and comparison to simulation.

[1] Kuech, T F et al., Journal of crystal Growth 68, no. 1 (1984): 48-53.

[2] Sakaki, H. et al. , Applied Physics Letters 51, no. 23 (December 7, 1987): 1934–36.

[3] Etienne, B., and V. Thierry-Mieg, Applied Physics Letters 52, no. 15 (April 11, 1988): 1237–39.

[4] Liu et al., J. Vac. Sci. Technol. B 32, no. 2 (2014).