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# Dielectric functions and optical constants modeling for $CuIn_3Se_5$ and $CuIn_5Se_8$

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The complex dielectric functions, $\varepsilon(\omega) = \varepsilon_1(\omega)+i\varepsilon_2(\omega)$, of $CuIn_3Se_5$ and $CuIn_5Se_8$ crystals with different Cu contents have been determined in the 0.8–4.7 eV photon energy range by using spectroscopic ellipsometry. The spectral dependence of the real, $\varepsilon_1(\omega)$, and imaginary, $\varepsilon_2(\omega)$, parts of $\varepsilon(\omega)$, as well as the complex refractive index, the absorption coefficient, and the normal-incidence reflectivity, has been modeled by using a modification of Adachi's model. The results are in excellent agreement with the experimental data over the entire range of photon energies. The model parameters, including the energies corresponding to the lowest direct gap, $E_0$, and to higher critical points, have been determined by using the simulated annealing algorithm.



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## References

D. Schmid, M. Ruckh, F. Granwald, and H. W. Schock, J. Appl. Phys. **73**, 2902 (1993)
L. Stolt, J. Hedstrom, J. Kessler, M. Puch, K. O. Velthaus, and H. W. Schock, Appl. Phys. Lett. **62**, 597 (1993).
H. Z. Xiao, L. Yang Chung, and A. Rockett, J. Appl. Phys. **76**, 1503 (1994).
G. Marín, S. M. Wasim, C. Rincón, G. Sánchez-Pérez, Ch. Power, and A. E. Mora, J. Appl. Phys. **83**, 3364 (1998).
C. Rincón, S. M. Wasim, G. Marín, and I. Molina, J. Appl. Phys. **93**, 780 (2003).
A. J. Nelson, G. S. Horner, K. Sinha, and M. H. Bode, Appl. Phys. Lett. **64**, 3600 (1994).
T. Negami, N. Kohara, M. Nishitani, T. Wada, and T. Hirao, Appl. Phys. Lett. **67**, 825 (1995).
C. Rincón, S. M. Wasim, G. Marín, R. Márquez, L. Nieves, G. Sánchez-Pérez, and E. Medina, J. Appl. Phys. **90**, 4423 (2001).

S. -H. Han, C. Persson, F. S. Hasoon, H. A. Al-Thani, A. M. Hermann, and D. H. Levi, Phys. Rev. B **74**, 085212 (2006).

M. I. Alonso, M. Garrida, C. A. Durante Rincon, and M. Leon, J. Appl. Phys. **88**, 5796 (2000)
J. G. Albornoz, R. Serna, and M. Leon, *ibid.* **97**, 103515 (2005).

H. Y. Deng and N. Dai, Phys. Rev. B **73**, 113102 (2006).

T. Kawashima, S. Adachi, H. Miyake, and K. Sugiyama, J. Appl. Phys. **84**, 5202 (1998).

T. Kawashima, H. Yoshikawa, S. Adachi, S. Fuke, and K. Ohtsuka, J. Appl. Phys. **82**, 3528 (1997).

A. B. Djurisic and E. Herbert Li, J. Appl. Phys. **85**, 2848 (1999).

M. León, R. Serna, S. Levcenko, A. Nateprov, A. Nicorici, J. M. Merino, and E. Arushanov, J. Appl. Phys. **101**, 013524 (2007).

J. E. Jaffe and A. Zunger, Phys. Rev. B **28**, 5822 (1983).

F. Jiang and J. Feng, Appl. Phys. Lett. **89**, 221920 (2006).

M. I. Alonso, K. Wakita, J. Pascual, M. Garriga, and N. Yamamoto, Phys. Rev. B **63**, 075203 (2001).

M. León, S. Levcenko, A. Nateprov, J. M. Merino, E. J. Friedrich, R. Serna, and E. Arushanov, J. Appl. Phys. **102**, 113503 (2007).

S. -H. Han, A. M. Hermann, F. S. Hasoon, H. A. Al-Thani, and D. H. Levi, Appl. Phys. Lett. **85**, 576 (2004).

S. -H. Han, F. S. Hasoon, J. W. Pankow, A. M. Hermann, and D. H. Levi, Appl. Phys. Lett. **87**, 151904 (2005).

S. B. Zhang, S. -H. Wei, A. Zunger, and H. Katayama-Yoshida, Phys. Rev. B **57**, 9642 (1998).



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