AD-A143 100 PHYSICAL PROPERTIES OF CDTE FILMS GROWN BY HOTWALL AND MOLECULAR BEAM TECHNIQUES(U) NORTH CAROLINA STATE UNIV RALEIGH J F SCHETZINA JUN 84 ARO-17772.11-EL 1/1

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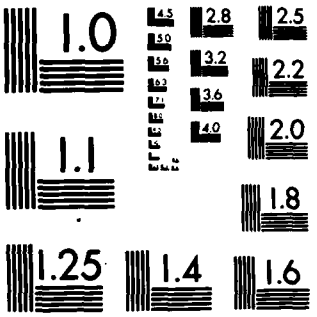

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18. SUPPLEMENTARY NOTES

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

CdTe, Hg CdTe, molecular beam epitaxy, sapphire, GaAs

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Results have shown that MBE and hotwall MBE techniques can be employed to grow high quality epitaxial CdTe films, suitable for use as substrates for Hg CdTe film growth, using alternative substrates. In particular,

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20. ABSTRACT CONTINUED:

CdTe / (0001) sapphire and CdTe / (100) GaAs provide viable alternatives to bulk CdTe for use as substrates in the 2-5 μm and 8-14 μm IR regions, respectively.

The most recent results indicate that layers grown by hotwall MBE are at least comparable to and, perhaps, superior to MBE grown films. This is an important finding because it implies that the CdTe epitaxial film growth process on these alternatives substrates may be "scaled-up" to meet production needs for substrate using batch processing techniques.

ARO 17772.11-EL

SUMMARY OF ACCOMPLISHMENTS AT NCSU UNDER

ARO SUPPORT OF INFRARED MATERIALS RESEARCH AT NCSU

March 1, 1984 - February 29, 1984

Publications and presentations which describe the work completed under ARO contract DAAG29-81-K-0055 are listed below:

PUBLICATIONS

"Molecular Beam Source for High Vapor Pressure Materials", J. Vac. Sci. Tech. 20, 134 (1982) (T.H. Myers and J.F. Schetzina).

"Properties of CdTe-Te Alloy Films Prepared Using Molecular Beams", J. Appl. Phys. 53, 5697 (1982) (T.H. Myers, A.W. Waltner, and J.F. Schetzina).

"Properties of CdTe/InSb Heterostructures Prepared by Molecular Beam Epitaxy", J. Appl. Phys. 53, 9232 (1982) (T.H. Myers, Yawcheng Lo, S.R. Jost, and J.F. Schetzina).

"Growth of CdTe Films on Sapphire by Molecular Beam Epitaxy", Appl. Phys. Lett. 42, 247 (1983) (T.H. Myers, Yawcheng Lo, R.N. Bicknell, and J.F. Schetzina).

"Effects of Surface Preparation on the 77 K Photoluminescence of CdTe", J. Appl. Phys. 54, 4232 (1983) (T.H. Myers, S.T. Edwards, A.F. Schreiner, and J.F. Schetzina).

"Growth of CdTe Films on Silicon by Molecular Beam Epitaxy", J. Appl. Phys. 54, 4238 (1983) (T.H. Myers, Yawcheng Lo, R.N. Bicknell, H.H. Stadelmaier, and J.F. Schetzina).

"Growth of Low Dislocation Density CdTe Films on Hydroplaned CdTe Substrates by Molecular Beam Epitaxy", J. Vac. Sci. Tech. A 1, 1598 (1983) (T.H. Myers, T.J. Magee, R.D. Ormond, and J.F. Schetzina).

"Photoluminescence from CdTe/Sapphire Films Prepared by Molecular Beam Epitaxy", J. Appl. Phys. 54, 6785 (1983) (S.T. Edwards, A.F. Schreiner, T.H. Myers, and J.F. Schetzina).

"Growth of (100) CdTe Films of High Structural Perfection on (100) GaAs Substrates by Molecular Beam Epitaxy", Appl. Phys. Lett., February 1 (1984) (with R.N. Bicknell, R.W. Yanka, N.C. Giles, T.J. Magee, C. Leung, H. Kawayoshi, and J.F. Schetzina).

"Growth of CdTe Films on Alternative Substrates by Molecular Beam Epitaxy", J. Vac. Sci. Tech. A 2, 423, (1984) (with R.N. Bicknell, T.H. Myers, and J.F. Schetzina).

PAPERS PRESENTED AT PROFESSIONAL MEETINGS

"Molecular Beam Growth System for High Vapor Pressure Materials", Bull. Am. Phys. Soc. 26, 1198 (1981) (T.H. Myers and J.F. Schetzina).

"Heteroepitaxial growth of CdTe Films by Molecular Beam Epitaxy", Bull. Amer. Phys. Soc. 27, 751 (1982) (Yawcheng Lo, R.N. Bicknell, T.H. Myers, and J.F. Schetzina).

"Homoepitaxial Growth of CdTe Films by Molecular Beam Epitaxy", Bull, Amer. Phys. Soc. 27, 751 (1982) (T.H. Myers, Yawcheng Lo, R.N. Bicknell, and J.F. Schetzina).

"Growth of Low Dislocation Density CdTe Films on Hydroplaned CdTe Substrates by Molecular Beam Epitaxy", 1983 U.S. Workshop on MCT, (Dallas) (T.H. Myers, R. Ormond, T. Magee, and J.F. Schetzina).

"Growth of CdTe Films on Alternative Substrates by Molecular Beam Epitaxy", National Symposium of the American Vacuum Society, (Boston) (1983) (R.N. Bicknell, T.H. Myers, and J.F. Schetzina).

"Properties of CdTe Grown Epitaxially on Sapphire by MBE", Proceedings of IRIS Infrared Detector Conference, (Boulder) (1983) (T.H. Myers, S.R. Jost, H.S. Cole, H.H. Woodbury, and J.F. Schetzina).

"Photoluminescence Studies of Epitaxial CdTe Films", SESAPS Meeting, (Columbia) (1983) (with N.C. Giles, R.N. Bicknell, T.H. Myers, and J.F. Schetzina).

"Photoconductivity Enhancement from Indium Incorporation in CdTe Films Grown on Sapphire by Molecular Beam Epitaxy", (Columbia) (1983) (T.H. Myers, and J.F. Schetzina).

"Properites of CdTe/Sapphire Epilayers Grown by Molecular Beam Epitaxy", Amer. Phys. Soc. March Meeting, (Detroit) (1984) (with R.W. Yanka, N.C. Giles, R.N. Bicknell, T.H. Myers, and J.F. Schetzina).

"Photoluminescence Studies of Epitaxial CdTe Films", Amer. Phys. Soc. March Meeting, (Detroit) (1984) (N.C. Giles, R.N. Bicknell, T.H. Myers, and J.F. Schetzina).

"Reflectance of AlAs-GaAs and InGa-GaAs Superlattices", Amer. Phys. Soc. March Meeting, (Detroit) (1984) (D.K. Blanks, W.D. Laidig, and J.F. Schetzina).

INVITED PAPERS AND COLLOQUIA

"Growth of CdTe on Alternative Substrates by MBE", DARPA IR Focal Plane Contractors Meeting, (Washington) (1982) (J.F. Schetzina).

"MBE Growth and Properties of CdTe on Alternative Substrates", General Electric Electronics Laboratory, Syracuse, NY (1983) (J.F. Schetzina).

"Properties and Applications of CdTe/Sapphire and CdTe/GaAs Thin Films", Physics, Duke University (1983) (J.F. Schetzina).

"Growth and Properties of CdTe Films on Alternative Substrates", General Electric Corporate Research Laboratory, Schenectady, NY (1983) (J.F. Schetzina).

"MBE Growth of CdTe/Sapphire and CdTe/GaAs Films", Ford Aerospace Laboratory, Newport Beach, CA (1983) (J.F. Schetzina).

STUDENTS SUPPORTED AT NCSU UNDER ARO CONTRACT DAAG29-81-K-0055

Yawcheng Lo, MS in Physics, 1982.
T.H. Myers, PhD in Physics, 1983.
R.W. Yanka, MS in Physics expected in June, 1984.
R.N. Bicknell, PhD in Physics expected in June, 1985.
D.H. Hinson, PhD in Physics expected in June, 1985.
N.C. Giles, PhD in Phyiscs expected in June, 1986.
D.K. Blanks, Post-Doctoral Research Associate.

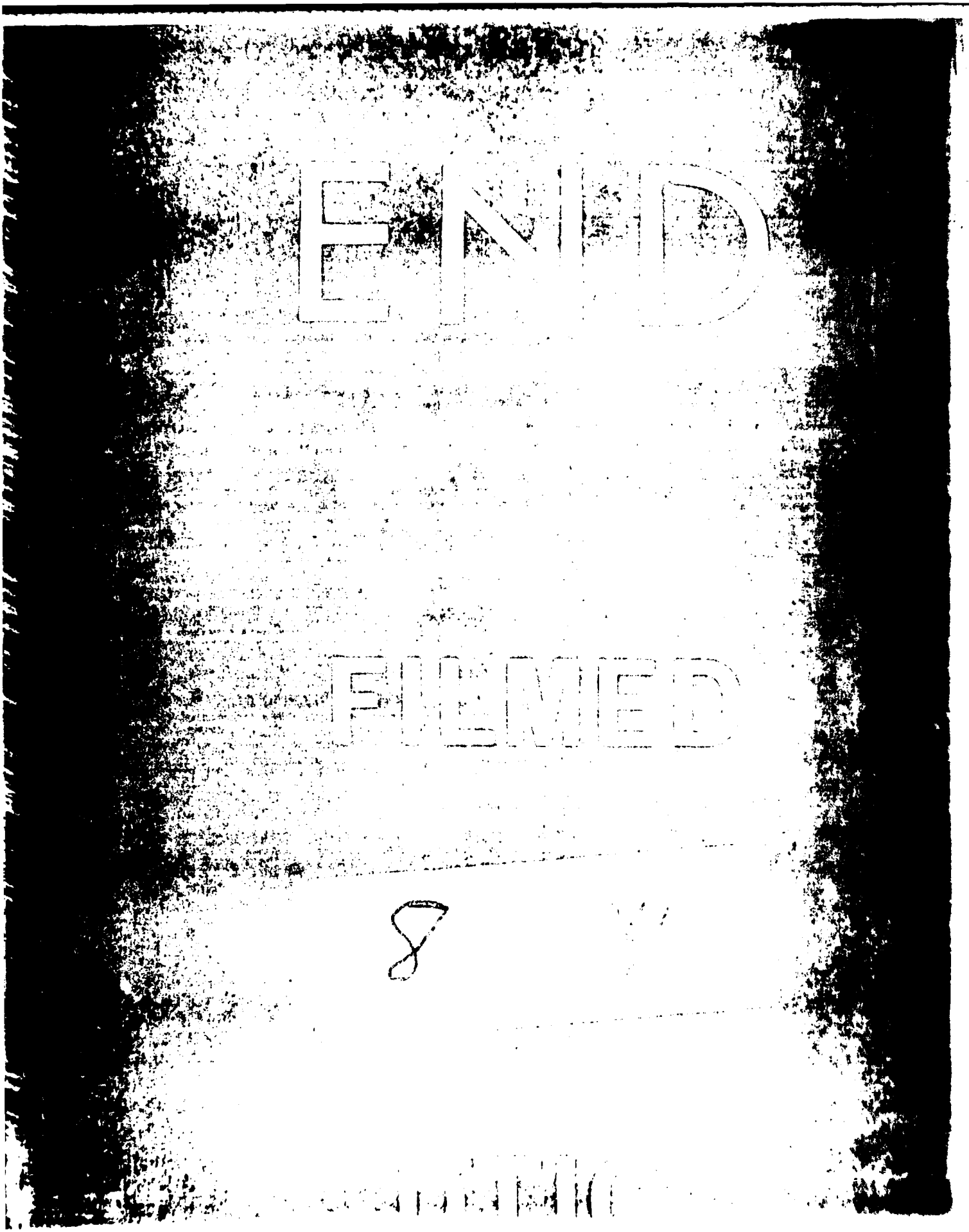
PRINCIPAL RESULTS OF RESEARCH

The interested reader is referred to the above publications for a full description of the results obtained at NCSU under ARO contract DAAG29-81-K-0055. In addition, the principal investigator (J.F. Schetzina) may be reached at (919) 737-2515 if further details of the completed work are desired.

Briefly, at NCSU we have shown that MBE and hotwall MBE techniques can be employed to grow high quality epitaxial CdTe films, suitable for use as substrates for Hg CdTe film growth, using alternative substrates. In particular, CdTe / (0001) sapphire and CdTe / (100) GaAs provide viable alternatives to bulk CdTe for use as substrates in the 2-5 μm and 8-14 μm IR regions, respectively. The above layers, grown at NCSU by MBE and hotwall MBE, show sharp x-ray diffraction patterns, low line dislocation densities (less than or equal to $10^4/cm^2$ for CdTe/ (100) GaAs), large photoconductivity and an exhibit a very bright photoluminescence dominated by a narrow (∿11 meV) near-edge peak of excitonic origin. Many of the CdTe layers on both sapphire and GaAs exhibit edge luminescence at room temperature, which is further evidence of their high quality.

Our most recent results indicate that layers grown by hotwall MBE are at least comparable to and, perhaps, superior to MBE grown films. This is an important finding because it implies that the CdTe epitaxial film growth process on these alternatives substrates may be "scaled-up" to meet production needs for substrate using batch processing techniques.

Work at NCSU dealing with CdTe film growth on sapphire and GaAs along with detailed structural, optical, and electrical characterization studies, is continuing at the present time under ARO contract DAAG29-84-K-0039.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