



University at Buffalo

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ARE GROUP-IV OXIDES THE ULTRAWIDE BANDGAP SEMICONDUCTORS OF THE FUTURE?



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Abstract: Group-IV oxides are an extremely interesting emerging class of ultra-wide bandgap semiconductors. In this talk, I will describe the two main classes of group-IV oxides and the work at the University of Minnesota on achieving high-performance electronic devices in these materials. The first class of materials is the stannate perovskite system. These materials, including BaSnO_3 , SrSnO_3 and CaSnO_3 , form a family of semiconductors with band gaps ranging from 3.1 eV to 4.4 eV, and which have high mobility and the ability to achieve extremely large carrier concentrations for ultra-low sheet resistivity. We have demonstrated field-effect transistors in all three of these materials and I will provide a comparison of their properties and device performance. I will also describe our planned work to explore the group-IV oxide family, rutile $(\text{Sn,Ge})\text{O}_2$. This is an extremely interesting material family for high-power applications, particularly pure r-GeO_2 , due to its wide band gap, potential for ambipolar conductivity capability, and high thermal conductivity. As part of this presentation, I will also provide a general overview of microelectronics research at the University of Minnesota, and our plans for a variety of initiatives through the CHIPS and Science Act.

Bio: Dr. Koester is the Russell J. Penrose Professor of Nanotechnology at the University of Minnesota, and Director of the Minnesota Nano Center. He received B.S.E.E. and M.S.E.E. degrees from the University of Notre Dame in 1989 and 1991, and the Ph.D. in 1995 from the University of California, Santa Barbara. From 1997 to 2010, he was a research staff member at the IBM T. J. Watson Research Center and performed research on a wide variety of electronic and optoelectronic devices, with an emphasis on those using the Si/SiGe material system. From 2006 to 2010 he served as manager of Exploratory Technology at IBM Research where his team investigated advanced devices and integration concepts for use in future generations of microprocessor technology. Since 2010, Dr. Koester has been a Professor of Electrical & Computer Engineering at the University of Minnesota where his research focuses on novel electronic, photonic, spintronic and sensing device concepts. Dr. Koester has authored or co-authored over 300 technical publications and conference presentations, 7 volumes, 4 book chapters, and holds 76 United States patents. He is a Fellow of the IEEE and Optica.

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