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FIVE reasons for SiC on Venus

www.WorkingonVenus.se

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Funded by KAW Wallenberg



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Background for SiC on Venus

- There are still things to be discovered about our nearest planet, even after 44 spacecraft sent to Venus since 1961.
- The USSR Venera landers could only work for about two hours due to the surface temperature of 460 °C.



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- The NASA Magellan and ESA Venus Express collected data from orbit.
- To determine if there is volcanic activity, which is needed for better climate modeling both for Venus and Earth, an in-situ mission is needed to last for more than 2 hours.



Reason 1 for SiC on Venus

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SiC Electronics can work for 2 months or even 2 years on Venus



Silicon Carbide High Temperature Electronics – Is This Rocket Science?, Zetterling, C.-M., Future Trends in Microelectronics: Frontiers and Innovations, ch. 7, p. 102 Edited by Luiryi, S., Xu, J. and Zaslavsky, A., John Wiley & Sons, 2013. http://dx.doi.org/10.1002/9781118678107.ch7



Reason 2 for SiC on Venus

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SiC Integrated Circuits can work even at temperatures of 600 °C



ECL-based SiC logic circuits for extreme temperatures, Lanni, L., Malm, B. G., Östling, M.,

and Zetterling, C.-M., Materials Science Forum, 821-823, p. 910, 2015.

http://dx.doi.org/10.4028/www.scientific.net/MSF.821-823.910

Integrated circuits in silicon carbide for high-temperature applications, Zetterling, C.-M.,

MRS Bulletin, vol. 40, p. 431, 2015. (Invited)

http://dx.doi.org/10.1557/mrs.2015.90



Reason 3 for SiC on Venus

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SiC devices can handle extreme environments



Effects of 3-MeV Protons on 4H-SiC Bipolar Devices and Integrated OR-NOR Gates, Suvanam, S.S., Lanni, L., Malm, B.G., Zetterling, C.-M., and Hallén, A., IEEE Transactions on Nuclear Science, vol. 61, p. 1772, 2014.

http://dx.doi.org/10.1109/TNS.2014.2310293



Reason 4 for SiC on Venus

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SiC converters can be designed for higher frequencies and lower losses



Design Steps Toward a 40-kVA SiC JFET Inverter With Natural-Convection Cooling and an Efficiency Exceeding 99.5%, Rabkowski, J., Peftitsis, D., and Nee, H.-P.,

IEEE Tran. Industry Applications, vol. 49, p. 1589, 2013.

http://dx.doi.org/10.1109/TIA.2013.2258132



Reason 5 for SiC on Venus

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SiC gas sensors can go places where other sensors don't survive



Increasing the Selectivity of Pt-Gate SiC Field Effect Gas Sensors by Dynamic Temperature Modulation, Bur, C., Reimann, P., Andersson, M., Schutze, A., and Spetz, A.L., IEEE Sensors Journal, vol. 12, p. 1906, 2012.

http://dx.doi.org/10.1109/JSEN.2011.2179645



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and a reason for Si on Venus

Seismic sensors can reveal if there is ongoing volcanic activity (but it needs SiC readout electronics)



Capacitive inertial sensing at high temperatures of up to 400°C, M. Asiatici, A. C.

Fischer, H. Rödjegård, S. Haasl, G. Stemme, F. Niklaus, IEEE Sensors and Actuators A, vol. 238, p. 361, 2016.

http://dx.doi.org/10.1016/j.sna.2015.12.025