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Space Solar Cells and Arrays

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10.1 THE HISTORY OF SPACE SOLAR CELLS

10.1.1 Vanguard I to Deep Space I

In the mid 1950s, the development of single-crystal photovoltaic (PV) solar cells based on Si, as well as GaAs, had reached solar conversion efficiencies as high as 6% [1, 2]. By 1958, small-area silicon solar cells had reached an efficiency of 14% under terrestrial sunlight. These accomplishments opened the door to the possibility of utilizing solar power on board a spacecraft. On March 17, 1958 the world's first solar-powered satellite was launched, Vanguard I [3]. It carried two separate radio transmitters to transmit scientific and engineering data concerning, among other things, performance and lifetime of the 48 p/n silicon solar cells on its exterior. The battery powered transmitter operated for only 20 days, but the solar cell powered transmitter operated until 1964, at which time it is believed that the transmitter circuitry failed. Setting a record for satellite longevity, Vanguard I proved the merit of space solar cell power. The solar cells used on Vanguard I were fabricated by Hoffman Electronics for the US Army Signal Research and Development Laboratory at Fort Monmouth. In 1961, many of the staff from the silicon cell program at Fort Monmouth transferred to the National Aeronautics and Space Administration (NASA), Lewis Research Center (now Glenn Research Center) in Cleveland, Ohio. From that time to the present, the Photovoltaic Branch at Glenn has served as the research and development base for NASA's solar power needs. Impressed by the light weight and the reliability of photovoltaics, almost all communication satellites, military satellites, and scientific space probes have been solar-powered. It should be noted that the history presented here focuses on the United States space program. NASA was created in 1958; the Institute of Space and Astronautical Sciences (ISAS) and the National Space Development Agency (NASDA) in Japan were created in 1965 and 1969, respectively;