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First steps towards the remote detection of radiation resistant life forms

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http://ssed.gsfc.nasa.gov/gunther/gunther/gunther.html

Extraterrestrial space is where life may have existed or still exists. Given our experience with terrestrial life we identify terrestrial organisms that are able to withstand significant doses of radiations. These are radiodurans (prokaryotes) and tardigrada and rotifera (eukaryotes). Radiation resistant organisms can repair very efficiently double strand brakes (DSBs) of DNA and this seems to be significant advantage in resistance against radiation.

Recent progress in understanding the radiation resistance in D. radiodurans is leading us to conduct an analysis of other radiation tolerant bacteria in an attempt to determine whether they are using similar or different strategies and to attempt answer the question of whether convergent evolution for radiation resistance (and/or desiccation tolerance) has taken place.

There may be 3 or 4 groups of genes for the complete radiation resistance. At the top of our list is the PprA gene and the Ddr[ABCD] genes. In the TIGR online database for Deinococcus, these are labeled: DR_A0346, DR_0423, DR_0070, DR_0003 and DR_0326 respectively.

The ability to chemically analyze liquid samples in situ will be critical for detecting and characterizing biologically significant organic species in exploration of the Solar System, including Mars, Enceladus, and Europa. Such liquid samples may also contain free floating fragments of DNA containing radiation resistant genes. We are developing a nanoscale chemical sensor based on a silicon nanowire transistor that promises sensitivity in the range of tens of femtomoles. The compact, low mass, low power nature of the sensor suggests that high redundancy or multiplexing of sensors will be possible. Furthermore, recent work reported in the literature has demonstrated that a carefully engineered functionalization of the sensor surface will enable highly specific detection of targeted molecules, including fragments of DNA containing specific radiation resistance genes. We will report on recent efforts to fabricate and characterize silicon nanowire transistors and discuss implications for the realization of a sensitive and adaptable chemical sensor technology.