Zinc as a biomarker can be used to diagnose the early stage prostate cancer, while ZIP1 protein, a zinc transporter is significantly down-regulated in prostate cancer cells. This behavior leads to the apparent alteration of the enrichment ability for zinc between early prostate cancer tissues and healthy tissues. This difference inspires us to develop a novel Zn^{2+} sensor that applies to the clinic diagnosis of early pros- tate cancer. We designed a tetrapeptide sensor H_2L (Dansyl-Gly-Pro-Trp-Gly-NH_2) according to the photo-induced electron transfer principle (PET), and it performed adequately in Zn^{2+} imaging of prostate cell lines. Based on the assessment of Zn^{2+} enrichment ability, there was distinctly lower Zn^{2+} concentrate in prostate cancer cell lines than healthy prostate epithelial cells. Furthermore, H_2L displayed high sen- sitivity with a detection limit as low as 49.5 nM, and high specificity for Zn^{2+} detection. Also the low tox- icity and the superior cell permeability of H_2L made the imaging of Zn^{2+} ions detection safe and rapid.