Sputter deposition of 50 nm thick NiO films on p+–n-Si and subsequent treatment in an Fe-containing electrolyte yielded highly transparent photoanodes capable of water oxidation (OER) in alkaline media (1 M KOH) with high efficiency and stability. The Fe treatment of NiO thin films enabled Si-based photoanode assemblies to obtain a current density of 10 mA/cm² (requirement for >10% efficient devices) at 1.15 V versus RHE (reversible hydrogen electrode) under red-light (38.6 mW/cm²) irradiation. Thus, the photoanodes were harvesting ~80 mV of free energy (voltage), which places them among the best-performing Si-based photoanodes in alkaline media. The stability was proven by chronoamperometry at 1.3 V versus RHE for 300 h. Furthermore, measurements with electrochemical quartz crystal microbalances coupled with ICP-MS showed minor corrosion under dark operation. Extrapolation of the corrosion rate showed stability for more than 2000 days of continuous operation. Therefore, protection by Fe-treated NiO films is a promising strategy to achieve highly efficient and stable photoanodes.