Halide perovskites have attracted tremendous research interest due to their potential applications in photovoltaics. In this work, we demonstrate reduced surface recombination velocity (SRV) and enhanced power-conversion efficiency (PCE) in mixed-cation mixed-halide perovskite solar cells by using a surface passivator of (3-aminopropyl)trimethoxysilane (APTMS). We show that APTMS passivates defects at the perovskite surface, while also decoupling the perovskite from detrimental interactions at the C60 interface. We measure an increase of ~100 meV in quasi-Fermi level splitting (QFLS) in APTMS-passivated devices compared to the control devices. We use time-resolved photoluminescence (TRPL) and excitation-correlation photoluminescence (ECPL) spectroscopy to show that APTMS passivation effectively suppresses non-radiative recombination. Furthermore, we show that APTMS improves both the fill factor (FF) and open-circuit voltage (VOC), increasing VOC from 1.03 V for control devices to 1.09 V for APTMS-passivated devices, and leads to a PCE increase from 15.90% to 18.03% on average. We attribute the enhanced performance to reduced defect density resulting in suppressed nonradiative recombination and lower SRV at the perovskite/transport layer interface. Finally, we use scanning probe microscopy (SPM) techniques, revealing that the APTMS polymerizes heterogeneously at the perovskite surface but still ensures efficient extraction of charge carriers.