We introduce double Bott-Samelson cells for any Kac-Peterson group $G$ and a pair of positive braids $b$ and $d$ as a moduli space of flags satisfying certain relative position conditions. Double Bott-Samelson cells are natural generalizations of double Bruhat-Cells introduced by Fomin and Zelevinsky. We prove that the coordinate rings of double Bott-Samelson cells are upper cluster algebras. We also construct the cluster Donaldson-Thomas transformation on double Bott-Samelson cells, and prove the Fock-Goncharov cluster duality for the corresponding cluster ensembles. This is joint work with Linhui Shen. (Received July 15, 2019)