A large number of experimental and theoretical studies have been reported on buckyball-containing nanotube (a.k.a. peapod) structures since the discovery of these materials. Recent advances in peapod synthesis techniques have led to the production of peapod materials with yields close to 90%. Successful synthesis of chains of $C_{60}$ molecules inside single-wall carbon nanotubes (SWCTs) involves depositing $C_{60}$ buckyballs on the surfaces of SWCTs from the gas phase. These buckyballs subsequently self-assemble inside the nanotube in chains called ‘bucky-peapods’ that are kept together by van der Waals interactions. We applied the recently developed Reactive Force Field (ReaxFF) to study the dynamic growth process starting from $C_{60}$-buckyball/nanotube peapod structures. We found that the space confinement provided by the single wall nanotube encapsulating the buckyballs is of critical importance to the coalescence reaction. We also simulated the effects of Ni-particles on the coalescence process and found a significant reduction of the reaction initiation temperature in the presence of these catalysts. One important quantity is the energy barrier of forming a 4-member ring between adjacent buckyballs. This barrier is lowered by 40% with the aid of catalysis. This research can help the community to gain better understanding of the complicated growth processes in fullerene systems.