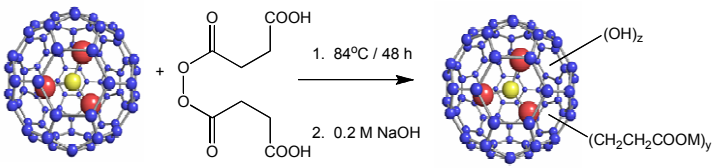
Supporting Information

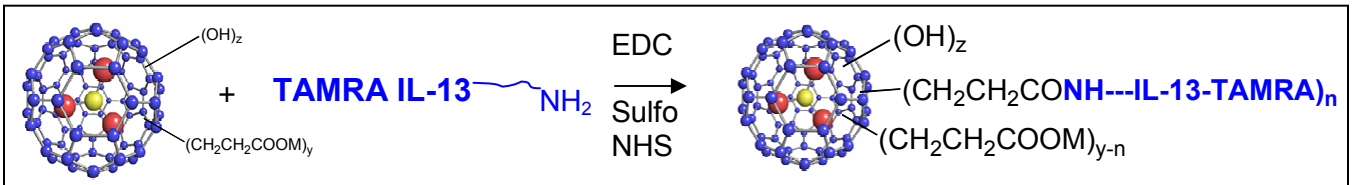
Preparation of $^{177}Lu_xLu_{(3-x)}N@C_{80}$. Samples were prepared using a modified Krästchmer-Huffman apparatus.[9] The apparatus was constructed primarily of a quartz cylinder with four ports -- one each for a cathode, anode, washer and drain. The drain was connected to a filter containing quartz wool and cellulose thimble. After each burn, the carbonaceous soot was washed with a pressurized solvent (toluene) into the drain. The insoluble portion of the soot was trapped in the cellulose thimble. The fullerene containing soluble fraction was collected in a round bottom flask with a sidearm to allow pressure adjustments. The 1/8" diameter, 3" long graphite rods (Alfa Aesar) were prepared for loading by drilling a 1/16" diameter, 1" deep hole. Then ~50 mg of Lu_2O_3 (Stanford Materials) was packed ~into the rod to serve as both a source of Lu for producing sufficient quantities of endohedral fullerenes, and as an absorbent for the injected $^{177}LuCl_3$ solution. Next, 10 microliters of 0.5 M HCl solution containing $^{177}LuCl_3$ (Perkin-Elmer) was transferred into the rod on top of the Lu_2O_3. Activity levels from 3 mCi to 12 mCi were placed in the rod, which was then heated in a tube furnace under nitrogen for 16 hrs at 500˚ C to drive off the water. The dried rod was cooled, measured for radioactivity by a dose calibrator for yield determination) and transferred to the anode. The chamber was evacuated and flushed twice with a mixture of He and N_2 gases (~5:1), and the chamber was subsequently filled to a pressure of 280 torr. During the burn, the pressure increased about 30 torr. The plasma was maintained during the burn by monitoring the gap voltage while the cathode was fed into the chamber, consuming the anode. About 1.5 inches of anode was consumed during each 1-2 min burn. After each burn, the chamber was allowed to cool and ~400 mL of toluene (pressurized at 90 PSI) was sprayed to wash the soot from the chamber. The metallofullerene/empty-cage fullerene rich extract was allowed to elute overnight through a column of Merrifield/cycopetadiene resin described previously.[10] The resulting sample was nearly free of empty-cage fullerenes. The metallofullerene was then ready for analysis in toluene, or transferred to *o*-dichlorobenzene for functionalization to make them water soluble and prepare them for conjugation to the fluorescent TAMRA labeled peptide.[13]

Carboxyl and Hydroxyl Functionalization of $^{177}Lu_xLu_{(3-x)}N@C_{80}$ (Scheme S1). The toluene was removed by rotovap and the $^{177}Lu_XLu_{(3-x)}N@C_{80}$ was dissolved in 5 mL of *o*-dichlorobenzene. Succinic acid acyl peroxide (~ 1 mg) was added in *o*-dichlorobenzene. The solution was de-oxygenated with flowing argon and heated at 84 °C for 48 h under constant stirring. At intervals of 12 h, additional succinic acid acyl peroxide (total of 4 mgs) was added. After the reaction, a brown sludge precipitated from the solution, which was then hydroxylated during extraction into a 0.2 M NaOH aqueous solution. The resultant aqueous of functionalized $^{177}Lu_xLu_{(3-x)}N@C_{80}$ was purified using a Sephadex G-25 size exclusion gel column with deionized water as eluent to obtain a narrow brown band with pH = 7-7.5.



Scheme S1. Synthesis of $^{177}Lu_xLu_{(3-x)}N@C_{80}(OH)_z(CH_2CH_2COOM)_y$ (M = H, Na; z ~26, y ~16).

Conjugation of $^{177}Lu_xLu_{(3-x)}N@C_{80}$ to TAMRA labeled Interleukin-13 peptide. The aqueous dispersion of $^{177}Lu_xLu_{(3-x)}N@C_{80}(OH)_{\sim 26}(CH_2CH_2COOH)_{\sim 16}$ was reduced in volume to ~ 50 µL under flowing N_2 and re-diluted in 200 µL of phosphate buffered saline (PBS) at pH 7.4 for a total volume of ~250 µL. The carboxyl groups were activated by the addition of 30µL of freshly prepared (in deionized water) 0.5 M 1-ethyl-3-[3-dimethylaminopropyl]carbodiimide hydrochloride (EDC) and 0.5 M N-hydroxysulfosuccinimide (Sulfo-NHS). After 15 min, β-mercaptoethanol (0.4 µL, 5.7 µmol) was added to quench the excess EDC to prevent activation of carboxyl groups on the peptide. Then 15 µL of 1µg/µL aqueous solution of fluorescent TAMRA labeled interleukin-13 peptide, specifically TAMRA-VDKLLLHLKKLFREGQFNRNFESIII C RDRT-OH, was added, vortexed and incubated at room temperature overnight.



Scheme S2. Conjugation of $^{177}Lu_xLu_{(3-x)}N@C_{80}(OH)_z(CH_2CH_2COOM)_y$ (M = H, Na) with TAMRA IL-13.

Characterization. All of the extract solutions possessed a yellowish-brown color, indicating the presence of fullerenes and metallofullerenes. One of the samples was characterized in toluene by an HPLC equipped with a UV/VIS and radioactive detector (**Figure S1**). The sample was reduced from 400 mL to 200 µL, from which a 10 µL sample was injected with toluene eluent flowing at 1mL/min through a 5mm PYE (Comisil) column. Yield determination and decomposition experiments were performed by measuring the counts per minute (cpm) on a gamma counter which was previously calibrated to determine the efficiency; these

values were then converted to disintegrations per minute (dpm), and dilution corrected to obtain the total activity obtained in the final product. The functionalized and conjugated sample was analyzed by polyacrylamide gel electrophoresis (PAGE) separation, followed by imaging of the gel in three modes (digital, fluorescent, and autoradiograph). Co-localization of the signals from the TAMRA labeled peptide and $^{177}Lu_{(x)}Lu_{(3-x)}N@C_{80}$ was used as verification of a successful conjugation.

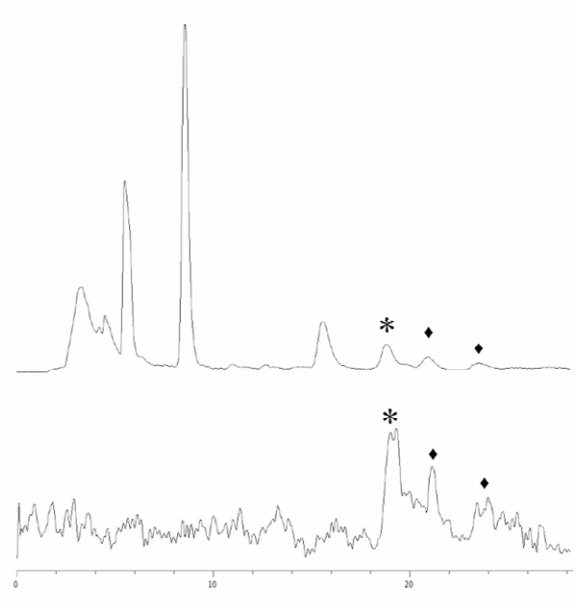


Figure S1. HPLC traces of $^{177}Lu_xLu_{(3-x)}N@C_{80}$ with detection at 390 nm (top) and with a radiation detector (bottom). The retention time of the starred (*) peak matches that for the non-radioactive sample of $Lu_3N@C_{80}$. The presence of ^{177}Lu is confirmed by the radioactive trace. The smaller trailing peaks (♦) after $Lu_3N@C_{80}$ are likely the previously unreported metallofullerenes $Lu_3N@C_{82}$, $Lu_3N@C_{84}$ and $Lu_3N@C_{86}$ that have also encapsulated ^{177}Lu.[S1]

S1. Chaur, M. N.; Melin, F.; Elliott, B.; Athans, A. J.; Walker, K.; Holloway, B. C.; Echegoyen, L. *J. Am. Chem. Soc*. **2007**, *129*, 14826-9. Fu, W.; Xu, L.; Azurmendi, H.; Ge, J.; Fuhrer, T.; Zuo, T.; Reid, J.; Shu, C.; Harich, K.; Dorn, H. *J. Am. Chem. Soc.* **2009**, *131*, 11762-11769. Zuo, T.; Beavers, C.; Duchamp, J.; Campbell, A.; Dorn, H.; Olmstead, M.; Balch, A. *J. Am. Chem. Soc.* **2007**, *129*, 2035-2043.