Supplementary Information

The modulatory effect of inhibitors on the thermal decomposition performance of graded Al@AP composite

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A. Basis for determining the proportion of graded aluminum powder.

According to the theory of maximum packing density, the densest volume fraction of spherical particles with a single sphere diameter is 0.74. Ideally, the addition of small particles will fill the voids between the large particles, thus increasing the overall packing density, and obtaining a mass ratio of large particles (25 μm) to small particles (0.2 μm) of 2.7:1.

B. Exact number of samples for differential scanning calorimetry and thermogravimetric analyses and rationale for sample size selection

Less than 5 mg per test in the DSC/TG test due to the energetic substances tested.

C. Details of pyrolysis gas chromatography mass spectrometry set-up parameters

Pyrolysis gas chromatography mass spectrometry (Py-GC/MS, GC1290) was employed to identify the pyrolysis products decomposed from the composites when the temperature reached up to 500 °C. Approxomately 0.8 mg of sample was placed in a quartz capillary tube of the pyroprobe and the entire assembly was kept in the pyrolyzer for thermal decomposition at 500 ℃ for 15 s. The decomposed gaseous products from pyrolyzer were injected in GC with injector temperature of 250 ℃. The GC oven temperature was programmed as follows: initially, the oven was at 100 ℃ for 2min. Then, it was ramped up at a rate of 10 ℃/min to 200 ℃ and maintained at this temperature for an addition 10min. The separated pyrolyzates from the GC were transferred to mass spectrometer (MS) via a heated interface which was at 200 ℃ temperature.

D. The SEM image of n-Al

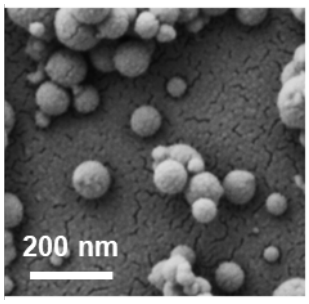


Figure S1. The SEM image of n-Al

E The SEM image of Al@AP/BM-52, Al@AP, BM-52 and BPE-1735

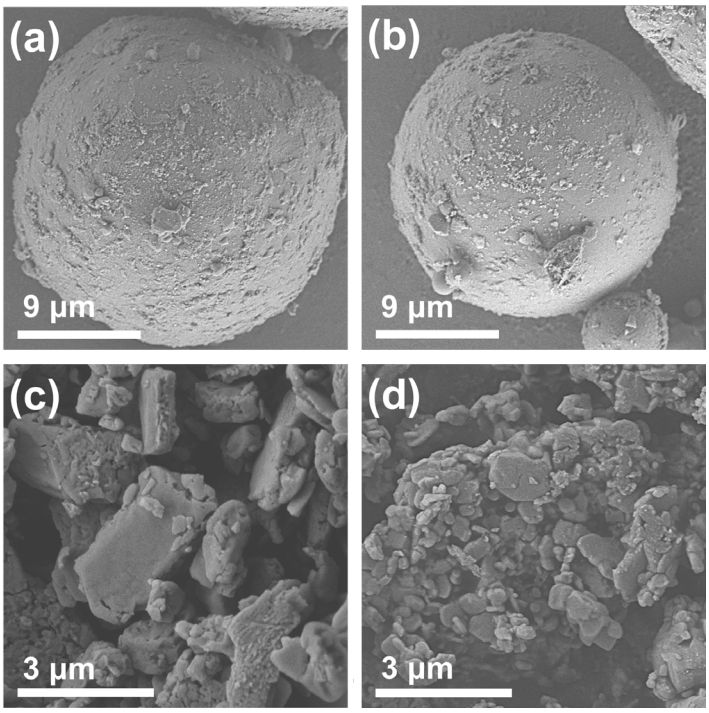


Figure S2. The SEM image of (a) Al@AP/BM-52, (b) Al@AP, (c) BM-52 and (d) BPE-1735

F. The DSC curves for (a): AP and (b): Al@AP at different heating rates

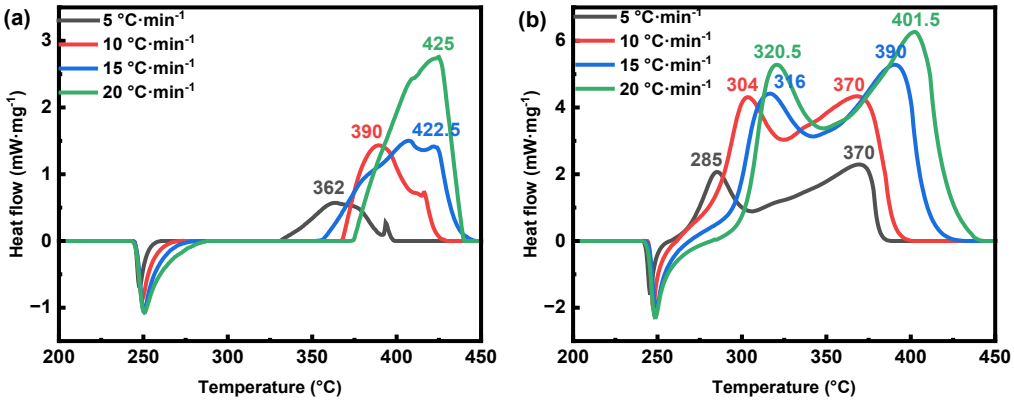


Figure S3. The DSC curves for (a): AP and (b): Al@AP at different heating rates

G. Kinetics parameters obtained using the Friedman Method and Combined Kinetic Method of the studied composite.

Table S1. Kinetics parameters obtained using the Friedman Method and Combined Kinetic Method of the studied composite.

Sample	Friedman		Combined kinetic method			
	E_a(kJ/mol)	r	E_a(kJ/mol)	cA(min^{-1})	m	n
AP-1st	127.9±2.4	0.9996	134.6±0.5	9.0E11±1.0E11	0.512	1.319

AP-2nd	191.9±3.2	0.9996	128.9±5.9	1.6E9±1.7E9	0.539	1.353
AP-3rd	177.8±9.0	0.9974	177.3±1.2	6.2E12±1.3E12	-0.033	0.321
Al@AP-1st	85.4±23.4	0.9326	98.8±3.9	5.2E6±4.1E6	0.665	0.745
Al@AP-2nd	82.2±15.1	0.9681	95.3±4.7	1.3E6±1.2E6	0.542	0.452
Al@AP-3rd	130±10.1	0.9940	113.7±0.7	1.6E8±2.2E7	0.612	0.427
Al@AP/BM-52-1st	134.8±12.9	0.9906	132.1±1.4	1.8E11±5.3E10	0.451	1.104
Al@AP/BM-52-2nd	220.2±22.9	0.9331	227.4±1.9	1.7E17±6.2E16	-0.492	0.517
Al@AP/BM-52-3rd	175.1±3.8	0.9995	220.2±5.4	3.6E16±3.5E16	0.388	0.744
Al@AP/ BPE-1735-1st	144.1±20.8	0.9798	172.3±2.1	5.1E11±2.3E11	0.429	1.119
Al@AP/ BPE-1735-2nd	212.8±10.3	0.9977	211.9±1.2	2.5E15±5.5E14	0.79	0.781
Al@AP/ BPE-1735-3rd	161.3±37.2	0.9507	192.6±2.8	2.9E14±1.5E14	-0.029	0.614