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Controllable growth of highly N-doped carbon nanotubes from imidazole:
Structural, spectroscopic and field emission study

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Supporting Information

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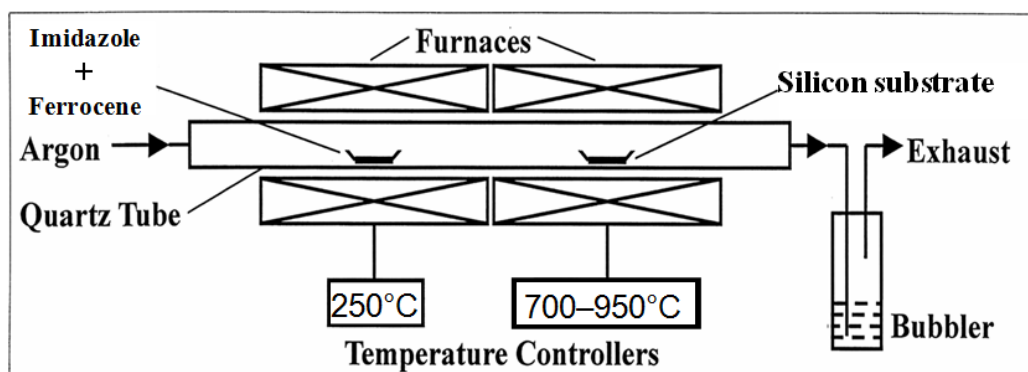


Fig. S1 A schematic diagram of the experimental set-up used for synthesizing N-doped CNTs.

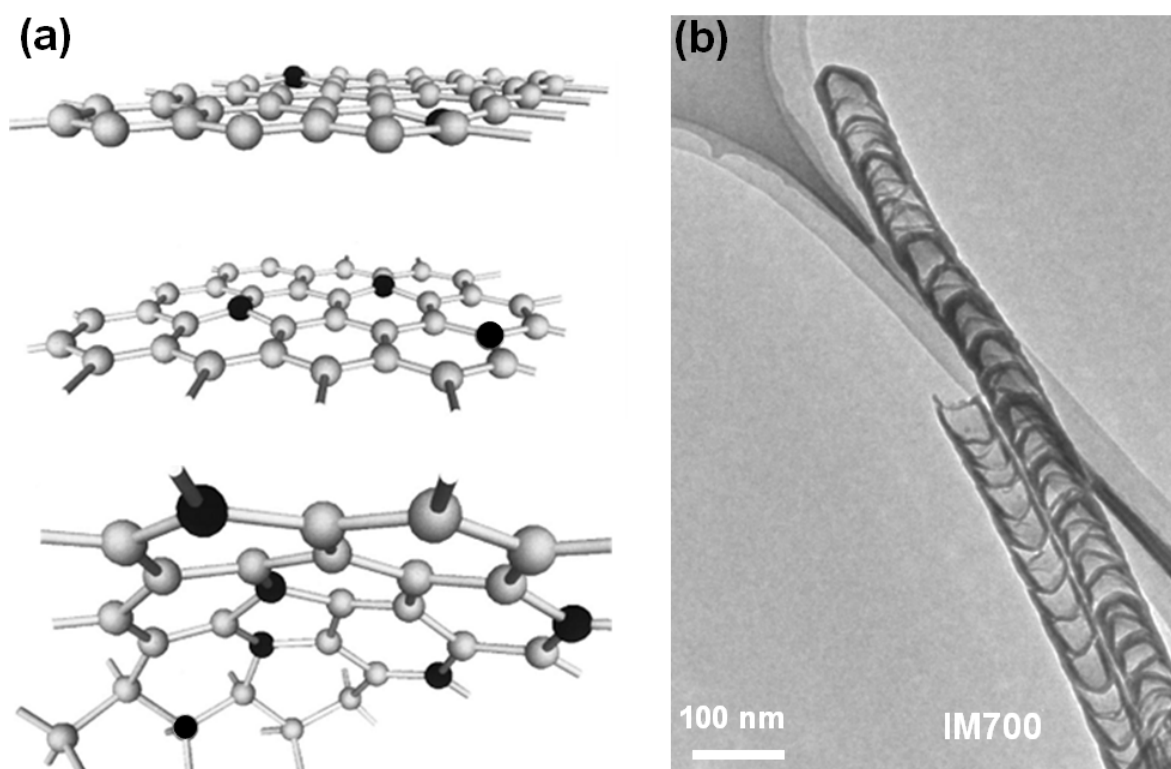


Fig. S2 (a) A model showing gradual increase in the curvature due to successive gN incorporation in a planar graphite layer. (b) Imidazole-grown CN_x synthesized at 700°C contains maximum pN-content (see Fig. 2b) and consequently possesses stacked-cup morphology.

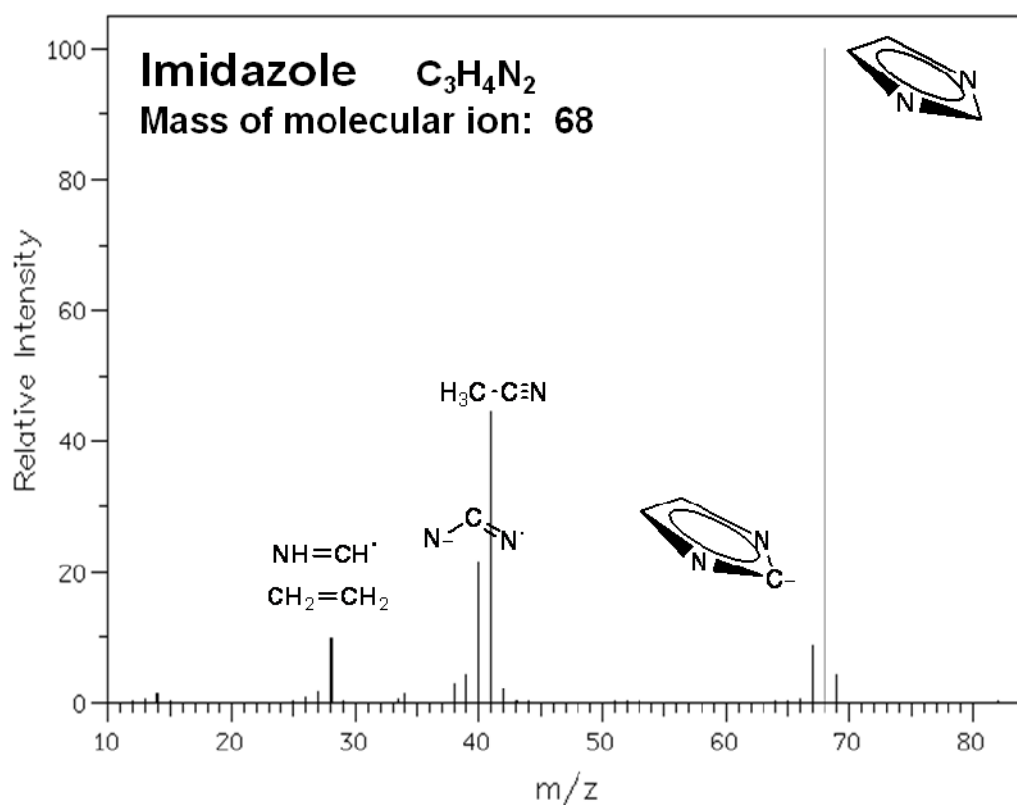


Fig. S3 Gas-chromatographic mass spectra of imidazole pyrolysis.

Table S1- Relative intensities of probable fragments as calculated from the above GCMS.

Mol. Wt.	Intensity	Probable fragments
28	10%	$H_2C=CH_2$ $HN=CH\cdot$
39	4%	
40	22%	$N=C-N\cdot$
41	45%	CH_3-CN
67	9%	$-C_3H_3N_2$
68	100%	$C_3H_4N_2$

Fig. S3 shows the GC-MS spectra of imidazole pyrolysis at 270°C. The spectrum reveals that there are a number of small fragmented units such as: C-C, C-N, N-C-N, C-C-N and $C_3N_2^-$; accompanied with more than 50% undecomposed imidazole present in the gas mixture. The recombination of the smaller fragments on the catalyst surface could result the hexagonal and pentagonal carbon ring, where each of which should contain at least one nitrogen atom as a substituent element. We could believe that with the increase of pyrolysis temperature up to 850°C the rate of fragmentation of imidazole precursor is relatively much easier to supply the higher quantities of C-N units. As a result, the nitrogen doping level in CN_x matrix have significantly been improved to 25.7 at.%.

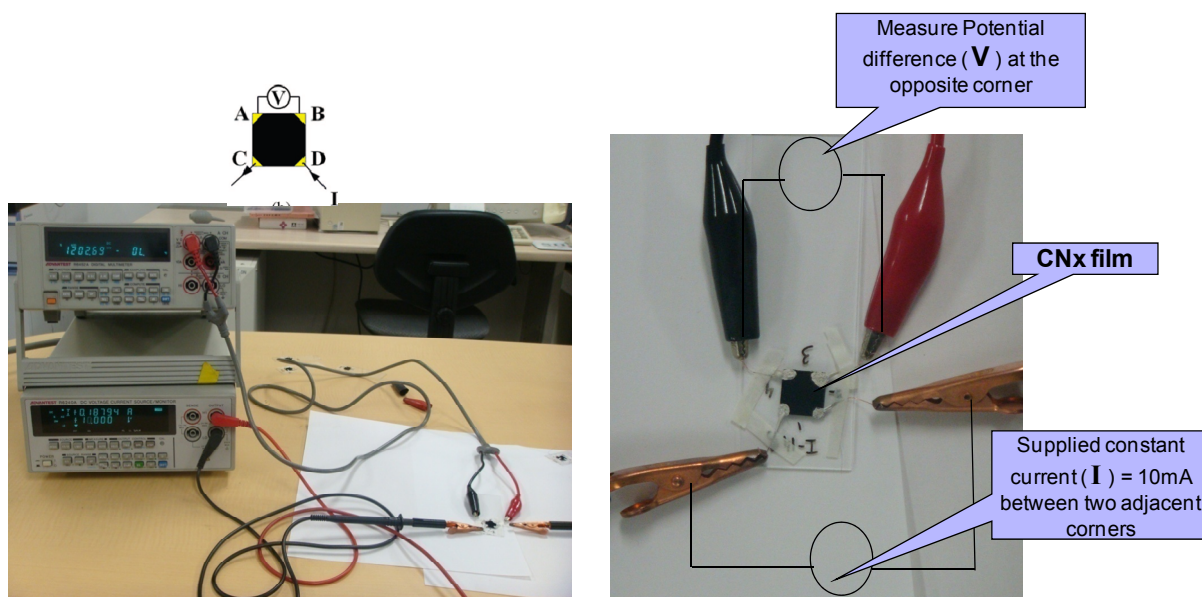


Fig. S4 Standard four-probe van der Pauw technique was used for the sheet resistance measurement of CN_x films.