

Fig. S1. Fungal biomass of the selected white rot basidiomycetes (*Bjerkandera adusta* and *Phanerochaete chrysosporium*) and saprotrophic ascomycete (*Morchella esculenta*) cultured in growth media for 1 (T1), 2 (T2) and 4 (T3) months with 0 (CTRL), 12.5, 25 and 50 $\mu\text{g FLG mL}^{-1}$. Bars marked with different letters indicates significant difference at $p < 0.05$.

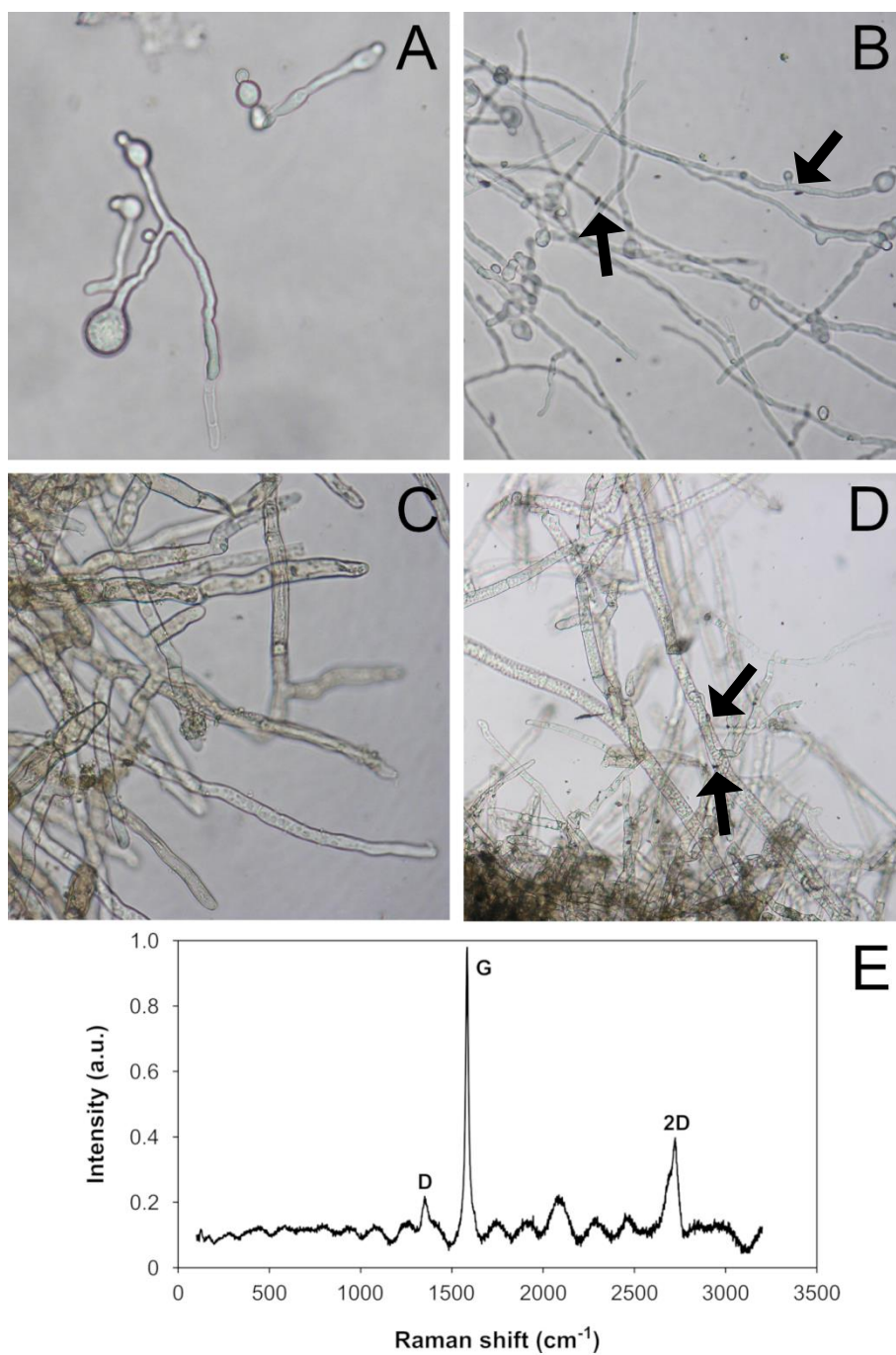


Fig. S2. *Phanerochaete chrysosporium* (A, B) and *Morchella esculenta* (C, D) mycelium growing in pure (A, C) and FLG-enriched (B, D) growth media. FLG aggregates in close contact with mycelia are indicated with arrows. Representative Raman spectrum of FLG in contact with mycelia is reported in E.

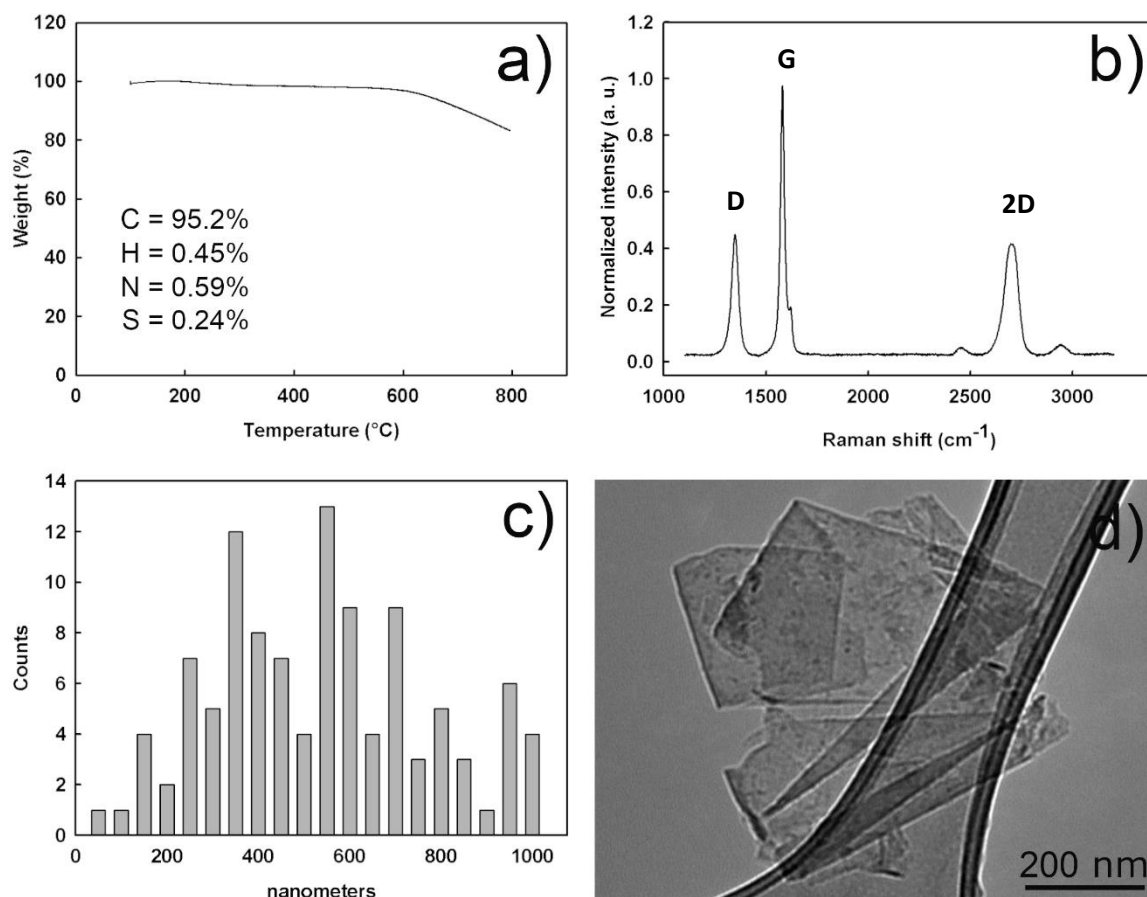


Fig. S3. Physical-chemical characterization of few-layer graphene (FLG): thermogravimetric and elemental analysis (a); average Raman spectra (b); lateral size distribution of sheets ($n = 100$) (c); representative TEM image of FLG (d).

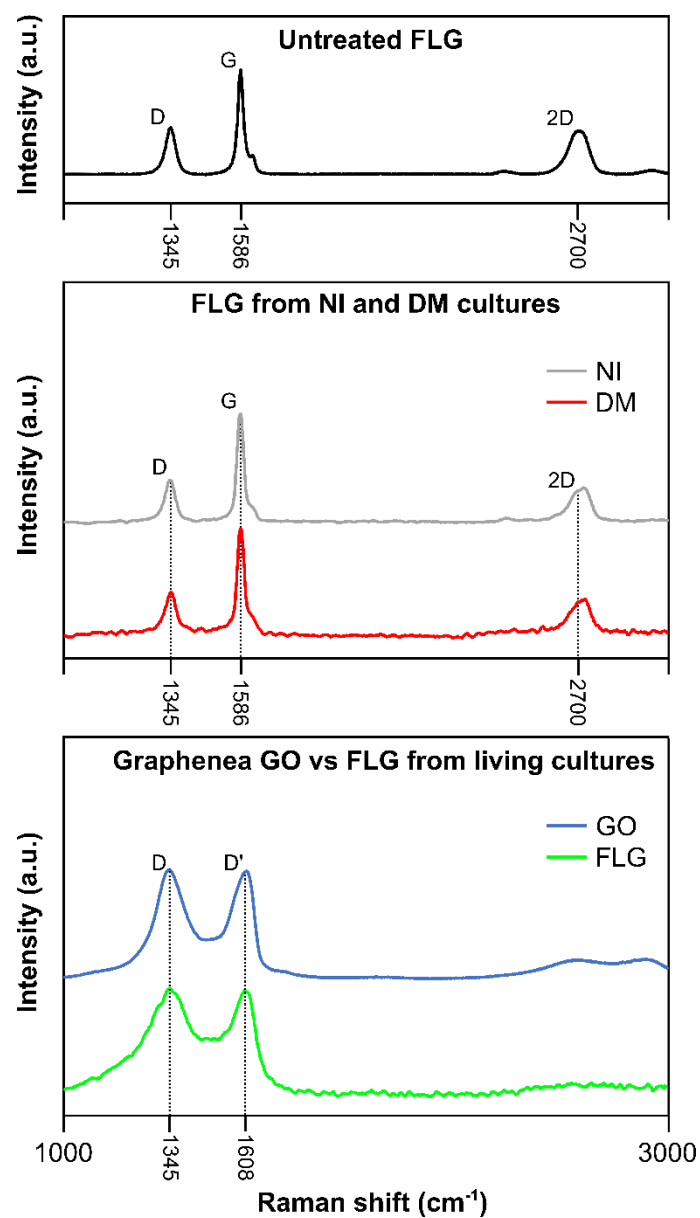


Fig. S4. Representative Raman spectra of untreated FLG flakes (black line) or flakes sampled from non-inoculated culture media (NI; grey line), devitalized (DM; red line) cultures or living cultures (green line). In the bottom panel a representative spectrum collected for a flakes of graphene oxide (GO; blue line) produced by Graphenea is reported for comparison.

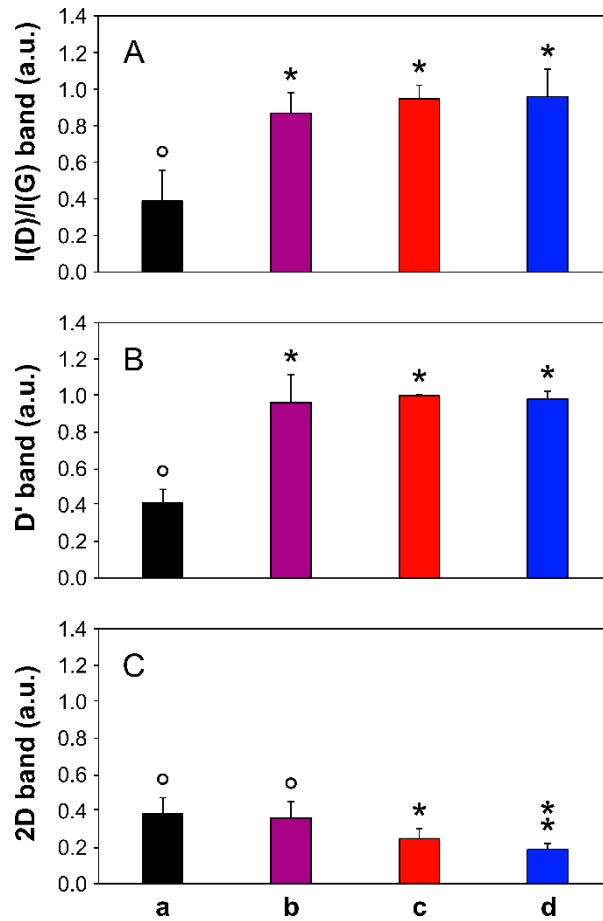


Fig. S5. Results of the one-way ANOVA-based comparison of average I(D)/I(G) values (A) and the intensity of D' (B) and 2D (C) bands among the four groups of spectra (a-d) identified by the cluster analysis applied to the whole Raman spectra of the 248 flakes sampled from non-inoculated, devitalized and living fungal cultures. The colour of the bars is the same of the concentration ellipses of Fig. 3B. Different symbols indicate a significant difference among group-specific average values.

Table S1. Results of the two-way ANOVA-based comparison of biomass values of the three fungi cultured for different times (T1-3) in growth media with different composition. The analysis was performed separately for each species. Fungi were grown in pure malt extract and glucose (MEG) liquid media or in MEG enriched with 25 $\mu\text{g mL}^{-1}$ of lignin (L), FLG (F) or both (F+L). Values are reported as mean \pm standard deviation (n=3).

Factor	<i>B. adusta</i>		<i>P. chrysosporium</i>		<i>M. esculenta</i>	
	<i>p-value</i>	Mass	<i>p-value</i>	Mass	<i>p-value</i>	Mass
Time (T)	<0.001		<0.001		<0.001	
T1 (1 month)		24.54 \pm 3.37 <i>a</i>		18.93 \pm 4.53 <i>a</i>		18.18 \pm 5.73 <i>a</i>
T2 (2 months)		107.95 \pm 7.81 <i>b</i>		72.74 \pm 19.33 <i>b</i>		20.28 \pm 4.78 <i>a</i>
T3 (4 months)		115.63 \pm 14.36 <i>b</i>		106.94 \pm 23.50 <i>c</i>		51.92 \pm 19.28 <i>b</i>
Growth media composition (GMC)	0.03		0.479		0.534	
Control (C)		80.94 \pm 41.77 <i>a</i>		59.14 \pm 34.58 <i>a</i>		34.57 \pm 22.81 <i>a</i>
Lignin (L)		90.25 \pm 48.84 <i>ab</i>		67.64 \pm 42.64 <i>a</i>		28.60 \pm 12.38 <i>a</i>
FLG (F)		77.25 \pm 42.91 <i>ab</i>		65.79 \pm 41.54 <i>a</i>		31.15 \pm 26.10 <i>a</i>
F+L		82.37 \pm 44.37 <i>b</i>		72.23 \pm 48.65 <i>a</i>		26.19 \pm 16.19 <i>a</i>
T \times GMC	0.483		0.364		0.664	
T1 \times C		25.89 \pm 2.39 <i>a</i>		18.17 \pm 3.56 <i>a</i>		20.65 \pm 6.00 <i>ab</i>
T1 \times L		26.73 \pm 1.02 <i>a</i>		23.26 \pm 5.49 <i>ab</i>		18.91 \pm 6.01 <i>ab</i>
T1 \times F		21.02 \pm 2.46 <i>a</i>		14.95 \pm 3.83 <i>a</i>		17.18 \pm 6.38 <i>a</i>
T1 \times F+L		24.50 \pm 4.60 <i>a</i>		19.35 \pm 1.61 <i>a</i>		15.98 \pm 7.01 <i>a</i>
T2 \times C		109.62 \pm 4.99 <i>bc</i>		66.57 \pm 15.45 <i>abc</i>		18.86 \pm 4.73 <i>ab</i>
T2 \times L		114.39 \pm 1.59 <i>bc</i>		65.84 \pm 24.19 <i>abc</i>		24.01 \pm 3.34 <i>ab</i>
T2 \times F		101.19 \pm 8.57 <i>b</i>		86.05 \pm 27.28 <i>cd</i>		20.80 \pm 6.95 <i>ab</i>
T2 \times F+L		106.60 \pm 9.87 <i>bc</i>		72.49 \pm 9.57 <i>bc</i>		17.45 \pm 2.75 <i>a</i>
T3 \times C		107.32 \pm 11.07 <i>bc</i>		92.69 \pm 15.60 <i>cd</i>		64.2 \pm 6.75 <i>c</i>
T3 \times L		129.64 \pm 16.87 <i>c</i>		113.82 \pm 22.35 <i>cd</i>		42.88 \pm 9.32 <i>abc</i>
T3 \times F		109.54 \pm 10.95 <i>bc</i>		96.37 \pm 15.77 <i>cd</i>		55.49 \pm 35.96 <i>bc</i>
T3 \times F+L		116.02 \pm 12.37 <i>bc</i>		124.87 \pm 31.96 <i>d</i>		45.13 \pm 13.51 <i>abc</i>

Table S2. Results of the two-way ANOVA-based comparison of I(D)/I(G) values of 248 flakes sampled from non-inoculated culture media (NI), living cultures of *Bjierkandera adusta* (*B. adu*), *Phanerochaete chrysosporium* (*P. chry*) and *M. esculenta* (*M. esc*) grown in presence of lignin (+) or not (-) and from the respective devitalized cultures (DM) of the same species. I(D)/I(G) values are reported as mean \pm standard deviation.

Factor	F	p-value	N	I(D)/I(G)
Inoculum	4.404	0.013		
Non-inoculated (NI)			12	0.447 \pm 0.162 <i>a</i>
<i>B. adusta</i> (<i>B. adu</i>)			81	0.713 \pm 0.334 <i>bc</i>
<i>P. chrysosporium</i> (<i>P. chr</i>)			80	0.790 \pm 0.281 <i>c</i>
<i>M. esculenta</i> (<i>M. esc</i>)			75	0.652 \pm 0.289 <i>b</i>
Compounds	0.719	0.398		
No compounds added (-)			97	0.769 \pm 0.307 <i>b</i>
with lignin (+)			95	0.819 \pm 0.253 <i>b</i>
with devitalized mycelia (DM)			56	0.408 \pm 0.173 <i>a</i>
Inoculum \times Compounds	5.595	< 0.001		
NI \times -			6	0.444 \pm 0.151 <i>ab</i>
NI \times +			6	0.450 \pm 0.196 <i>ab</i>
<i>B. adu</i> \times -			30	0.739 \pm 0.353 <i>bc</i>
<i>B. adu</i> \times +			30	0.917 \pm 0.210 <i>cd</i>
<i>B. adu</i> \times D			21	0.387 \pm 0.164 <i>a</i>
<i>P. chr</i> \times -			30	0.938 \pm 0.084 <i>d</i>
<i>P. chr</i> \times +			30	0.933 \pm 0.125 <i>d</i>
<i>P. chr</i> \times D			20	0.355 \pm 0.169 <i>a</i>
<i>M. esc</i> \times -			30	0.704 \pm 0.339 <i>b</i>
<i>M. esc</i> \times +			30	0.670 \pm 0.270 <i>b</i>
<i>M. esc</i> \times D			15	0.509 \pm 0.157 <i>ab</i>

F: F statistic computed for the two factors (i.e. “inoculum” and “compounds”; see section 2.9 for more details) and their interaction term (“inoculum” \times “compounds”) by ANOVA; N: number of analysed flakes per culture conditions.