

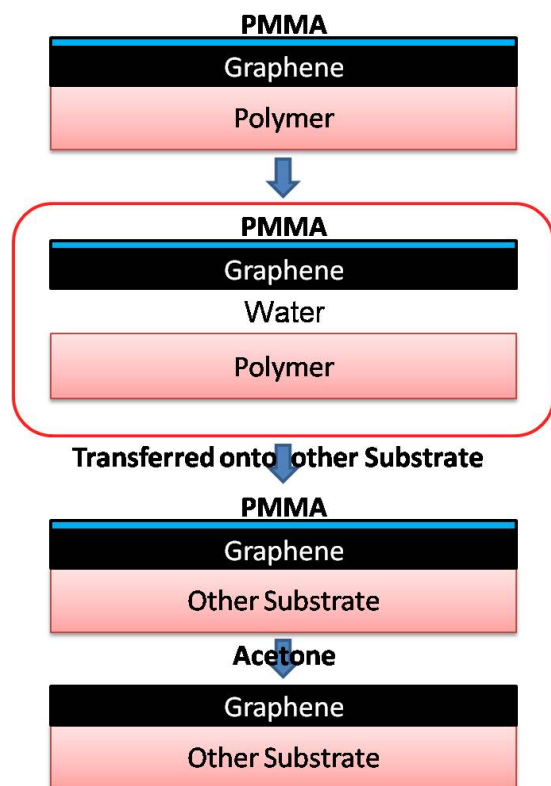


## ACS Material Trivial Transfer Graphene™ User Instruction for 4<sup>th</sup> Generation

This document is a guide for ACS Material customers to get a better understanding on how to work with our Trivial Transfer Graphene (TTG). Previous working experience is very helpful, and it might take several trials to achieve a successful transfer. As you develop skill, you will be able to adjust your technique based on your sample and specific experimental requirements.

### 1. Introduction

ACS Material provides you the easiest way to transfer single- or multi-layer graphene onto any substrate. All of the hard work has already been done. TTG will allow you to experiment with any novel substrate easily.

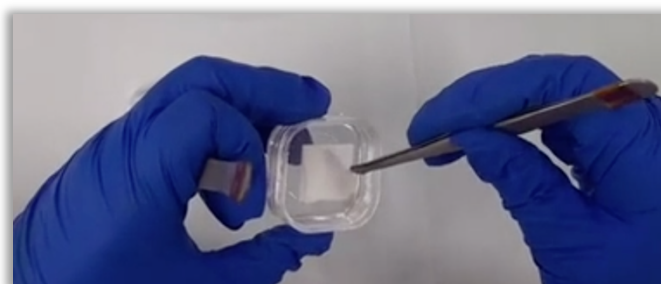


Flow Chart of ACS Material Trivial Transfer Graphene Transfer Procedure

### 2. TTG Release

Simply remove the top protecting layer and the TTG is ready to release! Please check this video on our website:

<https://www.acsmaterial.com/trivial-transfer-graphenetm.html>

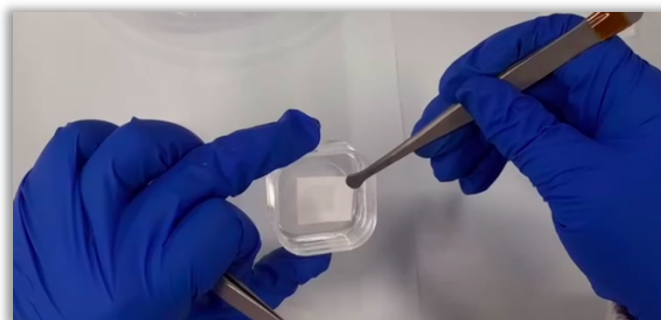


NOTE:

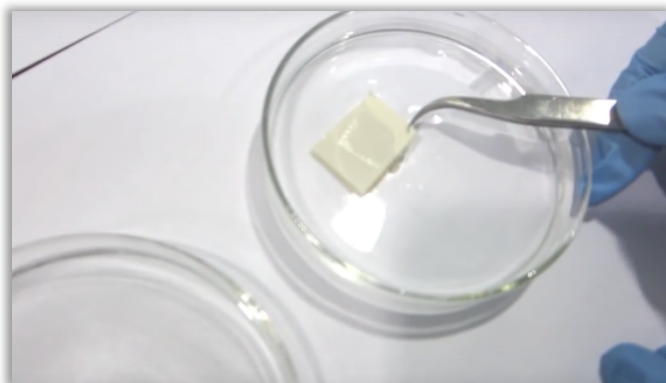
Please remove the protecting layer slowly and no need to add water droplets to wet the TTG anymore.

### 3. TTG Transfer

1) Remove TTG from the package using tweezers slowly and carefully.



2) Dip it into DI Water. Please immerse it as slowly as possible because the graphene layer will roll up if it's too fast. **Please be very careful** not to allow the TTG to flip over. The PMMA side must remain on top in order for the transfer process to be successful.



3) Once the TTG is released in the DI water, we suggest that you leave it there for at least 2 hrs. to make sure it's fully soaked before transferring it to the new substrate.


4) Use tweezers to hold the substrate to which you want to transfer TTG and then use the substrate to pick up the floating graphene film. Don't handhold the substrate. If you need to position the graphene onto the substrate, use another pair of tweezers to gently push the graphene into position but do not grab it. After the transfer, hold the substrate vertically for 1-2 minutes to let excess water flow out. Allow to naturally dry for 30 minutes and then bake at 100°C for 20 minutes. (NOTE: Please make best adjustments based on your own sample. Different substrates and sizes may need different time to dry and cure well. Make sure the wafer and graphene fully dried before baking to avoid air bubbles.)


### 4. PMMA Removal

1) After the water is completely removed, immerse the substrate and graphene into acetone to remove the PMMA. We suggest you preheat the acetone to 50°C. When the PMMA is rinsed off, usually after 30mins immersion into the acetone, we suggest that you bake

the substrate and graphene dry in the oven (<50°C) with the blower running on low speed for 10 minutes. NOTE: Please make best adjustments based on your own sample and specific experimental requirements.

2) For advanced PMMA removal techniques, please refer to the follow two papers:

 Pirkle, A., Chan, J., Venugopal, A., Hinojos, D., Magnuson, C.W., McDonnell, S., Colombo, L., Vogel, E.M., Ruoff, R.S. and Wallace, R.M., 2011. The effect of chemical residues on the physical and electrical properties of chemical vapor deposited graphene transferred to SiO<sub>2</sub>. *Applied Physics Letters*, 99(12), p.122108.

 Park, H., Brown, P.R., Bulović, V. and Kong, J., 2011. Graphene as transparent conducting electrodes in organic photovoltaics: studies in graphene morphology, hole transporting layers, and counter electrodes. *Nano letters*, 12(1), pp.133-140.

### 5. Storage

We recommend that you use our TTG products as soon as possible (within one month) after purchase. If not, please keep them in a refrigerator at 5-10°C for storage. We cannot guarantee the quality of these products after 2 months, if refrigerated; 1 month if not refrigerated.

NOTE: Our TTG products need to be packed in a humid environment, so it's normal if you see some water vapor on the package. Also, mold can develop on the polymer if not stored properly, but the quality of the graphene film is not affected at all and you just need to rinse the graphene film with DI water carefully at least 3 times before use.

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