

# Developing a Surface Enhanced Raman Spectroscopy based method for detecting pharmaceutical pollutants in treated wastewater

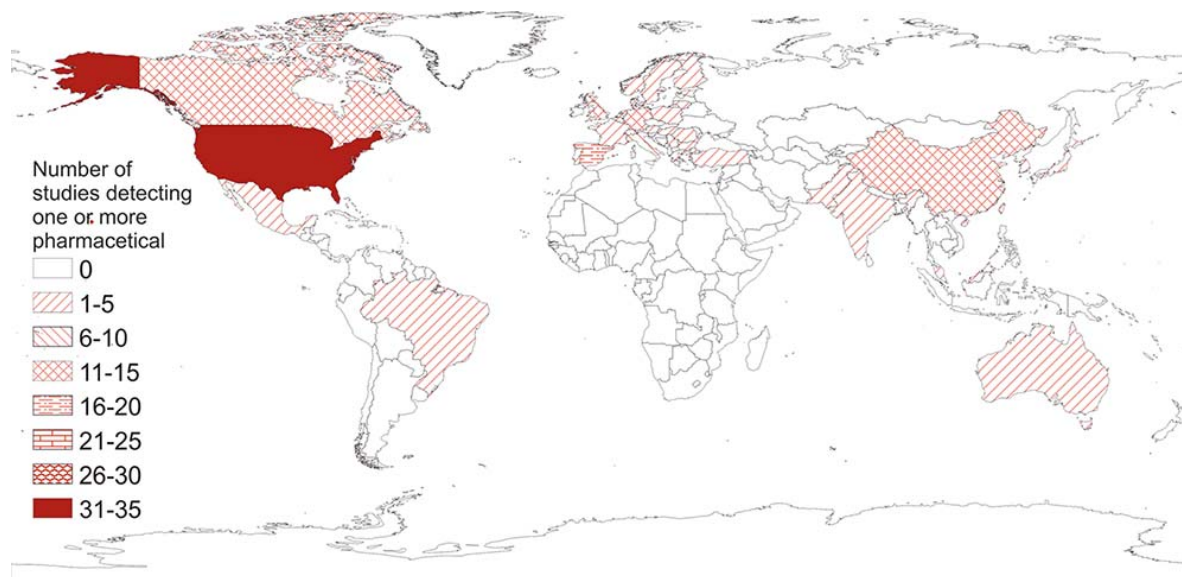
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# Pharmaceutical pollutants in Australia

- Most studies done in US, UK, China, Germany, Spain
- Fewer Australian studies



HUGHES, S. R., KAY, P. & BROWN, L. E. 2013. Global Synthesis and Critical Evaluation of Pharmaceutical Data Sets Collected from River Systems. *Environmental Science & Technology*, **47**, 661-677.

# Targeted pharmaceutical compounds

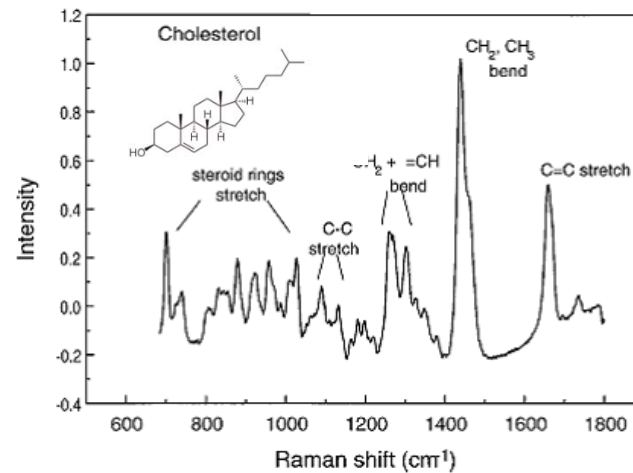
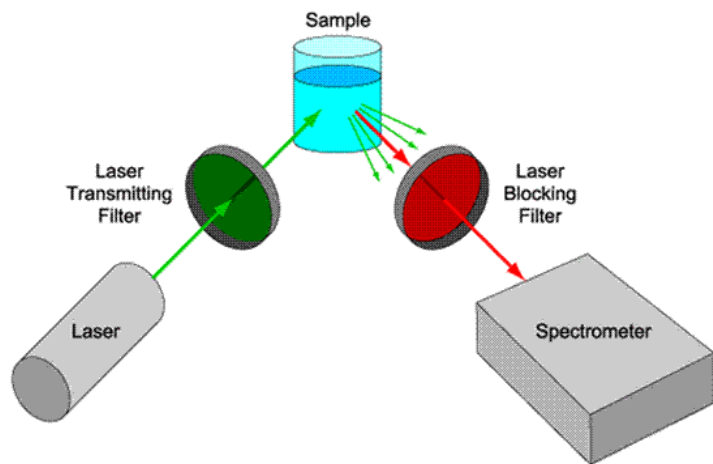
- PBS-published report
- Top 10 most dispensed prescription drugs in Australia in 2015
- Concentrations in Australian wastewaters less studied

Drug	Amount used per year (kg)
Atorvastatin	114
Perindopril	79
Rosuvastatin	71
Amlodipine	63
Paracetamol	60,559
Irbesartan	65,717
Candesartan	56
Ramipril	52
Telmisartan	47
Esomeprazole	47

ONG, T. T. X., BLANCH, E. W. & JONES, O. A. H. 2018. Predicted environmental concentration and fate of the top 10 most dispensed Australian prescription pharmaceuticals. *Environmental Science and Pollution Research*.

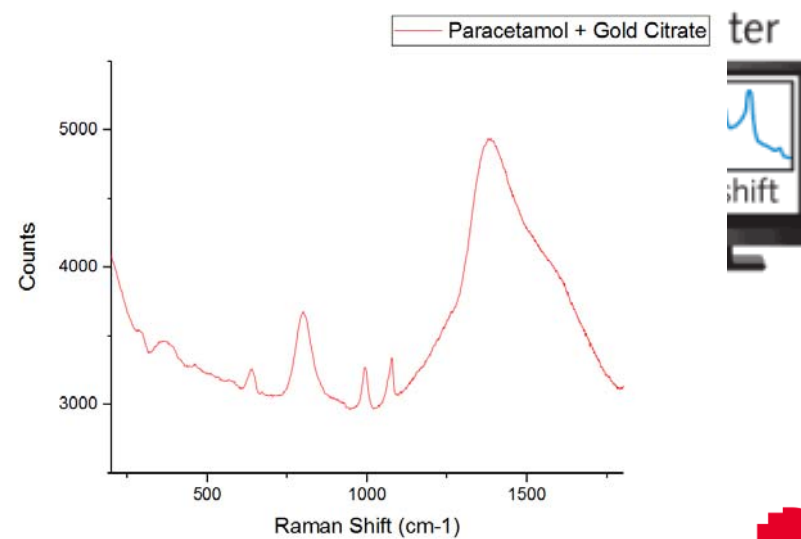
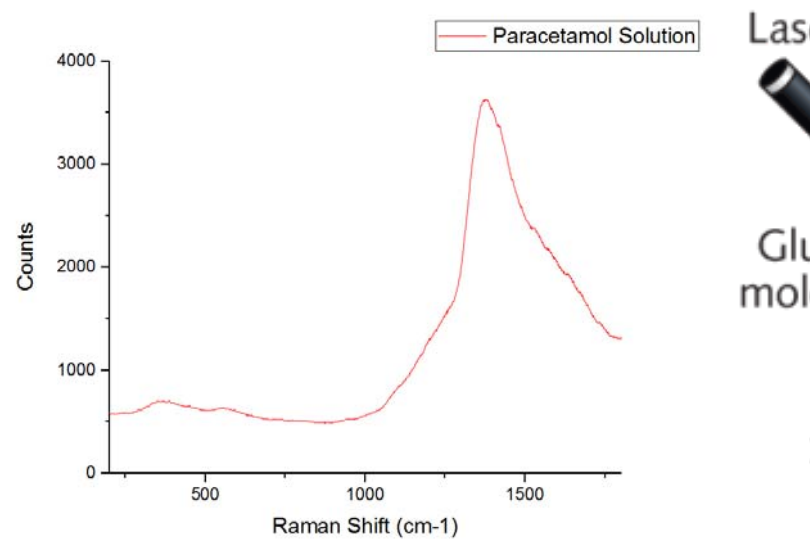
# Raman Spectroscopy

- Vibrational spectroscopy technique for identifying molecules, chemical bonding
- Widely used, powerful analytical technique
- Raman scattering typically weak



# SERS

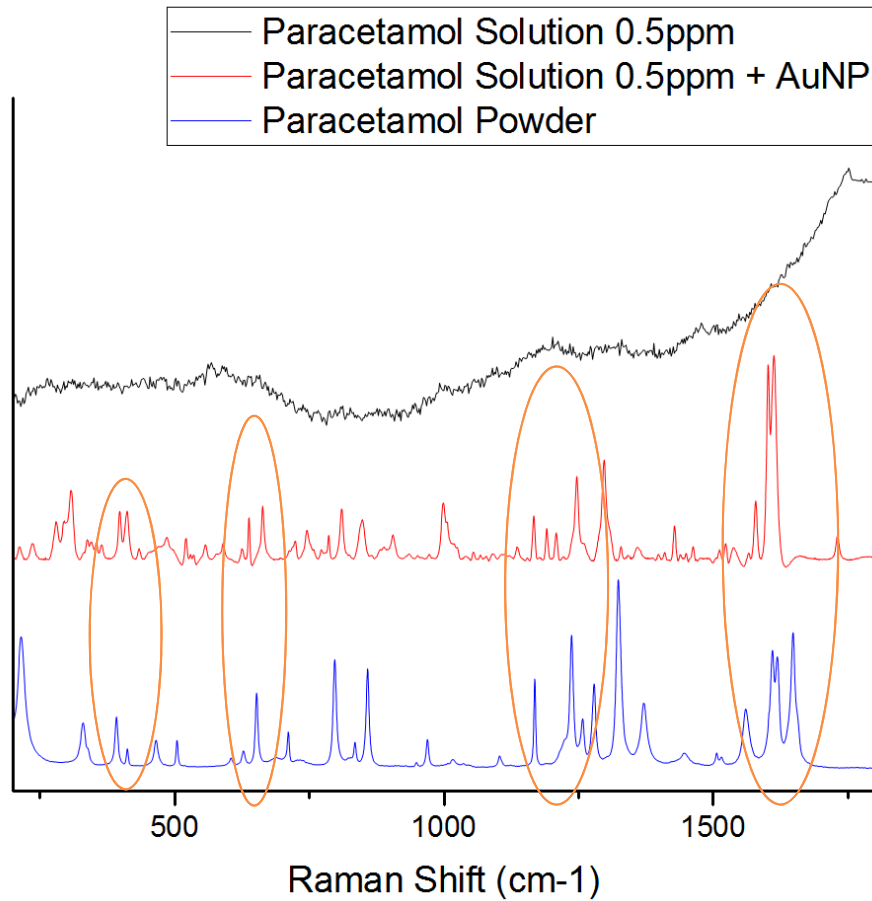
- Increases Raman signal boost by several orders of magnitude
- Utilises noble metal nanoparticles, enhancement in electric field by metal surface, selective band enhancement
- Typically  $10^{4-6}$  enhancement



[http://research.chem.psu.edu/lxjgroup/page16\\_files/blocks\\_image\\_1\\_1.png](http://research.chem.psu.edu/lxjgroup/page16_files/blocks_image_1_1.png)

[http://aemstatic-ww1.azureedge.net/content/dam/etc/medialib/new-lib/biooptics-world/print-articles/volume-4/issue-3/1483.res/\\_jcr\\_content/renditions/pennwell.web.400.210.gif](http://aemstatic-ww1.azureedge.net/content/dam/etc/medialib/new-lib/biooptics-world/print-articles/volume-4/issue-3/1483.res/_jcr_content/renditions/pennwell.web.400.210.gif)

# SERS of Paracetamol



Unpublished data

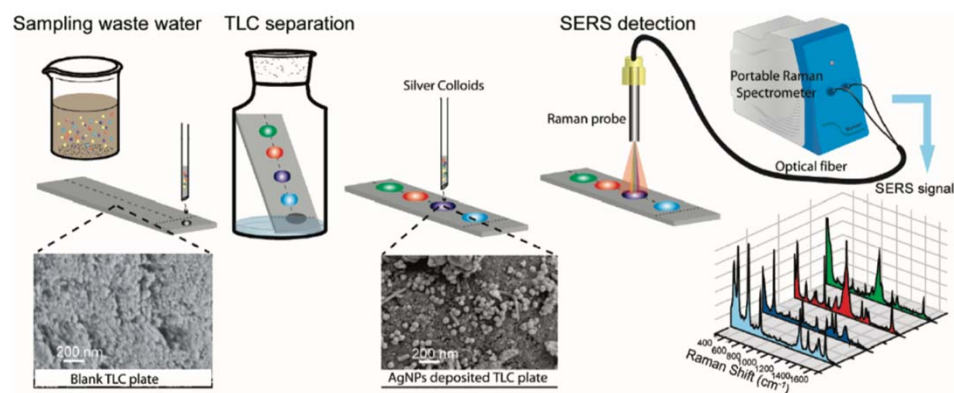
- 0.5ppm concentration of Paracetamol
- 10 second acquisition time

# Advantages of Raman Spectroscopy

- Can be performed on liquid/solid samples
- Measurement times in the range of seconds/minutes instead of hours
- Can be performed in the field via portable Raman spectrometers, good for routine measurements
- Requires less sample preparation, technical expertise compared to Mass Spectrometry

# Future of environmental SERS?

- Methods that can solve confusion between target and non-target analytes and can be performed in the field
- TLC-SERS?



LI, D., QU, L., ZHAI, W., XUE, J., FOSSEY, J. S. & LONG, Y. 2011. Facile On-Site Detection of Substituted Aromatic Pollutants in Water Using Thin Layer Chromatography Combined with Surface-Enhanced Raman Spectroscopy. *Environmental Science & Technology*, **45**, 4046-4052.



**Thank you for  
listening**

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