The origins of SCOM16

(An international workshop, “Strong Coupling in Organic Materials”, held in San Sebastian, 2016)

The topic of strong coupling in the context of confined light fields interacting with ensembles of molecules had exploded in the few years leading up to this workshop. This workshop, and the accompanying special issue of ACS Photonics, marked an important first ‘coming of age’ in the formation of a community of scientists working in this topic area.

In December 2015 three of the organisers (WLB, JA, FGV) were part of a farewell symposium at the AMOLF institute in the Netherlands on the occasion of a colleague of ours, Prof. Jaime Gomez-Rivas, leaving AMOLF to take up a new position in the Dutch energy research organisation, Differ, in Eindhoven. Somewhat to our surprise all three of us gave talks that discussed strong coupling. Further, Jaime also talked about strong coupling. Discussion at the event naturally led to the idea of running a scientific workshop on the topic; this was the genesis of the first international meeting on this topic, SCOM: strong-coupling of organic molecules.

The guiding principle behind the workshop was that it should be driven by those working in the field, we wanted it to be a meeting of minds without the formalities and extras associated with a large-scale sponsored event, one at which contributors could maximise the time spent discussing new science. We were very fortunate to be able to host the meeting at Donostia International Physics Centre in San Sebastian Spain, a very convivial and attractive venue, as well as one with a strong record for top-level scientific meetings. Clearly others thought so too - we were both pleased and fortunate that everyone we invited wanted to come. Towards the end of the meeting one of the invited speakers, Prof Harry Atwater, suggested a special issue of ACS Photonics should be devoted to the topic of the meeting. Again we were delighted that so many contributors accepted this invitation as well; the result was a volume that we thought captured the stat-of-the-art and highlighted the great potential for this topic area.

Strong coupling of ensembles of organic molecules with confined light fields was first reported by Lidzey et al. in 1998 and although interest gradually picked up in the years that followed, it was been the pioneering work of Ebbesen and co-workers through a slew of fascinating results that demonstrated the power of the strong coupling process to modify molecular and material properties. We were delighted that both Lidzey and Ebbesen both took part in the workshop, and that they also contributed to the special issue. The meeting was followed up by a second workshop, SCOM18, held in Eindhoven in The Netherlands in April 2018.

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2. Then I think we need to identify why this is an emerging topic, what makes it interesting, how it is impotent in different areas (sub-fields).

Strong coupling of molecules inside optical cavities is an offshoot of an earlier but still very active field of cavity quantum electrodynamics. Traditionally cavity quantum electrodynamics is concerned with single (or few) atoms or ions in a cavity, and has been a proving ground for many aspects of quantum mechanics. When an atom is strongly coupled to an optical cavity mode two new hybrid polariton modes are formed, part matter, part light. At first sight there does not seem to be anything significantly new as the number of atoms or molecules is increased. However, the energy splitting between the tow polariton modes scales with the square toot of the number of molecules involved. For an optical cavity of wavelength scale dimensions filled with molecules the splitting can reach ~1eV, i.e. comparable with the energy of the non-interacting molecular mode. It is thus possible to very significantly modify some of the molecular properties, something that has been explored and confirmed recently in a number of theoretical works. Strong coupling offers a new type of engineering to the molecular world, something Ebbesen has called ‘vacuum engineering’, the vacuum part referring to the fact that this energy splitting of the polariton states, and thus the modification of the molecular properties, is something that does not require light to be present, it is a vacuum effect (it is known as vacuum Rabi splitting).

3. We should try and give an overall description of what the contributions top the special issue provide for the community.

I need to take a look through what we have and sketch a paragraph or two on this – I will try and do so tonight.

4..and we could then have a very short section looking to the future.

Any suggestions???