

# San Sebastian, a City of (Nano)Science and Technology

San Sebastian (Donostia in the Basque language) is a beautiful, medium-sized European city of about 200,000 inhabitants located at the heart of the Basque Country, next to the Atlantic Ocean and the Pyrenees. Long known as a tourist and culinary destination, San Sebastian has recently become a city of science and technology, with a strong focus on nanoscience research and characterized by an interdisciplinary approach and the support of intense industrial activity in the region. The San Sebastian nanoscience community has contributed considerably to *ACS Nano* with more than 100 publications during the past decade, some of which have already had significant impact and are highlighted in this [virtual issue](#). This activity has turned this small point at the Basque coastline into a worldwide “nano”-pole for a variety of focused areas of nanoscience research.

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The origin of this development can be traced back to the launching of international academic activity in condensed matter physics at the University of the Basque Country (UPV/EHU) in the late 1980s and 1990s; it was with the sustained support of the Basque government that this academic potential could fully develop. At the beginning of the present century, Basque authorities implemented a number of initiatives with the long-term objective of placing the Basque Country at the forefront of research and technology in various strategic areas, in particular, materials science, biosciences, energy, and nanotechnology. In the framework of this strategy, and in the context of an existing network of technology centers, the Basque Excellence Research Centers (BERCs) and the Cooperative Research Centers (CICs) were created to drive and to dynamize the Basque system of science and technology. Together with the creation of these new research centers, the *Ikerbasque* Science Foundation was launched to attract high-profile scientists from all over the world. These initiatives, further supported by institutions such as the University of the Basque Country, Donostia city hall, the regional government of Gipuzkoa, the Spanish Research Council, the Spanish Ministry of Science, and the European Commission, set up the basis for significant enhancement of the research carried out in the Basque Country.

Of particular importance is the nano activity in the city of San Sebastian, both at the campus of the UPV/EHU and at the Gipuzkoa Science and Technology Park just a few kilometers away, creating a combined *research pole* for nanoscience and nanotechnology. At the university campus, nanoscience activity is led by a number of centers in pursuit of competitive growth of the Basque Country, namely, the *Nanoscience Cooperative*

*Research Center* (CIC nanoGUNE), which joins efforts with three cutting-edge BERC centers on campus; the *Donostia International Physics Center* (DIPC); the *Materials Physics Center* (CFM-MPC), created as a joint initiative of the UPV/EHU and the Spanish Research Council (CSIC); and the Basque Center for Macromolecular Design and Engineering (*Polymat*). At the Gipuzkoa Science and Technology Park, the *Center for Cooperative Research in Biomaterials* (CIC biomaGUNE); the Technology Centers *Cidetec*, *CEIT*, and *Tecnalia*; and the Health Institute *Biodonostia* drive cutting-edge research on bionanotechnology and nanomedicine; at the core of this science and technology park, a number of companies are dedicated to the development of nanotechnology, including nanoGUNE's start-up company *Graphenea*, as well as *Bihurcrystal* and *Asparia Glycomics*, which are start-ups of the Materials Physics Center and CIC biomaGUNE, respectively.

San Sebastian's investment in nanoscience activities has begun to pay off. A number of research groups have contributed to high-impact research in nanoscience and nanotechnology, as shown in numerous *ACS Nano* papers published in the past few years. Research areas include the use of scattering-type near-field optical microscopy for the study of nanoscale infrared spectroscopy of individual nanoparticles and films,<sup>1,2</sup> pioneering contributions in the field of nanoparticle synthesis<sup>3–6</sup> and assembly,<sup>7–9</sup> the study of plasmonic nanoantennas<sup>10–12</sup> and nanocavities,<sup>13–15</sup> the analysis of electron tunneling across molecular junctions at surfaces,<sup>16</sup> and photoemission-based studies of topological insulators.<sup>17</sup> A significant effort has been dedicated to phenomena at interfaces, including the fabrication of high-quality metal surfaces,<sup>18</sup> various investigations on the growth and properties of graphene nanoribbons at metal surfaces,<sup>19–22</sup> the synthesis and characterization of conjugated molecules,<sup>23,24</sup> and the spectroscopic analysis of semiconducting surfaces.<sup>25–27</sup> Nanomedicine research has been reported in the fields of bioimaging,<sup>28–30</sup> biofunctionalization,<sup>31</sup> biomolecular interactions,<sup>32</sup> carbon dots for radical scavenging,<sup>33</sup> and biosensing.<sup>34</sup> More recent, promising publications include the development of plasmonic superlattices as surface-enhanced Raman spectroscopy substrates,<sup>35</sup> the description of surface-enhanced electron energy loss spectroscopy,<sup>36</sup> the mechanism behind anti-icing processes,<sup>37</sup> chirality-induced electron spin polarization,<sup>38</sup> ferromagnetic barriers in superconductors,<sup>39</sup> and plasmonic phenomena in ultrathin metallic films.<sup>40</sup> These are just a few examples of the wide variety of state-of-the-art nanoscience research performed in San Sebastian, as witnessed by the *ACS Nano* readership.

A number of important papers in nanoscience have resulted from collaborations between research groups at the different research centers in San Sebastian. This collaborative work has been combined with our commitment toward industrial

Published: November 18, 2019

development of nanotechnology both locally and worldwide, which has led not only to an increase in top-notch industrial research in our community but also to the launch of a number of promising nanotechnology-based start-up companies.



**Figure 1.** Aerial view of San Sebastian. The Gipuzkoa Science and Technology Park oversees the city, with the UPV-EHU University Campus located near Ondarreta beach and La Concha bay. Image credit: Gipuzkoa Science and Technology Park.

The future of our activity is bright and hopeful, as the political and administrative support from the Basque authorities is long-standing. We can proudly say that San Sebastian is much more than a beautiful city.

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### Notes

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