

ASX RELEASE

20 June 2019

## IMEC COLLABORATION and PATENT UPDATE

- **Completed analysis of third iteration of 300mm wafers (“Lot 3”)**
- **Most significant lot to date, demonstrating the repeatability of the process**
- **Achieved improved characteristics from those obtained on wafer D17 in Lot 2**
- **Wafer D10 in Lot 3 produced the best results**
- **Processing of fourth iteration of wafers (“Lot 4”) to commence within weeks**
- **Lot 4 will comprise 2 sets of 23 wafers, which will be processed in parallel, and with the results of their analysis expected to be announced during Q3 of 2019**
- **Lot 4 is potentially the final iteration before integration with imec’s 1 megabit memory platform commences**
- **Ten additional patent applications filed to strengthen the Company’s intellectual property position**

4DS Memory Limited (ASX:4DS) (**4DS** or the **Company**) is pleased to provide an update on both its collaboration with imec, its development partner, and 4DS’s patent status.

### imec Collaboration Update

On 20 February 2019, the Company reported that wafer D17 in Lot 2 demonstrated the best characteristics with respect to endurance and retention – two core characteristics for Storage Class Memory on which the testing and analysis was focused. 4DS was able to achieve endurance cycling into the millions, a first for the Company, and retention analysis showed the best retention results outside of its own facilities.

On 2 April 2019, the Company announced that imec had commenced the processing of twenty three 300mm wafers (**Lot 3**), being twenty three wafers with process condition variations of wafer D17 from Lot 2, so as to identify the impact of such changes on the desired memory characteristics.

The Company is now pleased to advise that imec was successful in processing the wafers in Lot 3, and that they have been analysed extensively by both imec and 4DS. Importantly, there were demonstrable improvements in key areas relevant to developing a Storage Class Memory – speed, endurance, and retention – over and above those obtained from wafer D17 in Lot 2, with wafer D10 in Lot 3 (the 10<sup>th</sup> wafer in Lot 3) producing the best results:

- Endurance cycling has now moved into the tens of millions;
- Retention was further improved from Lot 2 and again is the best seen to date outside of 4DS facilities; while
- Higher endurance and improved retention were achieved without compromising speed.

In addition, the Company has for the first time demonstrated compatibility with the backend-of-line temperatures required for integration with imec’s proven megabit memory platform processes on 300mm wafers.

This is a significant achievement for the Company as it represents the **second time** it has been able to replicate and improve certain characteristics on the same multi-million dollar state-of-the-art production equipment used by high volume/high density manufacturers of memory.

The details of the analysis remain confidential to the Company and imec under the terms of the collaboration agreement.

The next iteration of 300mm wafers (**Lot 4**) will comprise of process condition variations to wafer D10 Lot 3. The processing of Lot 4 will commence within weeks with imec's state-of-the-art production equipment. Lot 4 will comprise of two sets of twenty three 300mm wafers (46 in total), that will be processed and analysed in parallel, thereby expediting the transition to imec's 1 megabit memory platform.

The objective of Lot 4 will be to further optimise speed, endurance and retention, with the results of the analysis of Lot 4 expected during Q3 of 2019. This optimisation is a required and logical step before the Company integrates its technology onto imec's 1 megabit memory platform, potentially after the completion of the analysis of Lot 4. In turn, this brings the Company closer to its goal of ultimately being able to produce a 1 megabit memory chip.

Megabit memories are the minimum size needed to collect the statistically significant and meaningful data on yield, endurance, speed and data retention that are essential for high-volume memory makers to make informed decisions.

Chief Executive Officer and Managing Director, Dr Guido Arnout, commented "We are pleased with our Lot 3 results and we look forward to continuing to work closely with imec to reach the ultimate goal of a 1 megabit chip as soon as possible. The data from the next wafer lot will be invaluable as we move closer to that goal."

The Company looks forward to updating the market on the results of Lot 4 during Q3 of 2019.

### **Patent Update**

The Company now has twenty granted US patents, three pending patents and has filed an additional ten US patent applications to protect its stream of innovations and to strengthen its intellectual property portfolio in the area of Interface Switching ReRAM for Storage Class Memory close to DRAM. Some of these filed patents have been placed on a fast track granting process and the Company is filing additional patent applications.

The Company looks forward to updating the market as these applications become US granted patents.

**ENDS**

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### **About 4DS**

4DS Memory Limited (ASX: 4DS), with facilities located in Silicon Valley, is a semiconductor development company of non-volatile memory technology, pioneering Interface Switching ReRAM (Non-Filamentary ReRAM), for next generation gigabyte Storage Class Memory. Established in 2007, 4DS owns a patented IP portfolio, comprising 20 granted US patents and 3 patents pending, which has been developed in-house to create high density Storage Class Memory. 4DS has a joint development agreement with Western Digital subsidiary HGST, a global storage leader, which accelerates the evolution of 4DS' technology. 4DS also collaborates with imec, the world's #1 independent semiconductor development institute.

For more information, please visit [www.4dsmemory.com](http://www.4dsmemory.com).

## About imec

imec is the world-leading research and innovation hub in nanoelectronics and digital technologies. The combination of our widely acclaimed leadership in microchip technology and profound software and ICT expertise is what makes us unique. By leveraging our world-class infrastructure and local and global ecosystem of partners across a multitude of industries, we create ground breaking innovation in application domains such as healthcare, smart cities and mobility, logistics and manufacturing, energy and education.

As a trusted partner for companies, start-ups and universities we bring together close to 3,500 brilliant minds from over 75 nationalities. Imec is headquartered in Leuven, Belgium and also has distributed R&D groups at a number of Flemish universities, in the Netherlands, Taiwan, USA, China, and offices in India and Japan. In 2016, imec's revenue (P&L) totalled 496 million euro. Further information on imec can be found at [www.imec-int.com](http://www.imec-int.com).

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For more information, please visit [www.imec.be](http://www.imec.be).

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