

UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

CIVIL ACTION NO. 22-11378-RGS

MODERNATX, INC.,
and MODERNA US, INC.

v.

PFIZER INC., BIONTECH SE,
BIONTECH MANUFACTURING GMBH,
and BIONTECH US INC.

MEMORANDUM AND ORDER ON
CLAIM CONSTRUCTION

August 1, 2023

STEARNS, D.J.

Plaintiffs ModernaTX, Inc. and Moderna US, Inc. (collectively, Moderna) accuse defendants Pfizer Inc. (Pfizer), BioNTech SE, BioNTech Manufacturing GmbH, and BioNTech US Inc. (collectively, BioNTech) of infringing United States Patent Nos. 10,898,574 (the '574 patent), 10,702,600 (the '600 patent), and 10,933,127 (the '127 patent). Before the court are the parties' briefs on claim construction. The court received tutorial presentations and heard argument pursuant to *Markman v. Westview Instruments, Inc.*, 517 U.S. 370 (1996), on July 27, 2023.

THE PATENTS

The '574 patent, which issued on January 26, 2021, and claims priority to April 2, 2012, is entitled “Delivery and Formulation of Engineered Nucleic Acids.” It is directed to “the delivery of modified mRNA molecules in order to modulate protein expression.” '574 patent, col. 4, ll. 65-67; *see also id.*, col. 1, ll. 32-34. mRNA, or messenger ribonucleic acid, contains the genetic information needed for ribosomes to create a protein. For more than a decade, scientists have recognized the potential value of mRNA in the development of more effective vaccines: If mRNA containing the genetic information for a viral protein could be introduced directly into the human body, it could teach the body to create antibodies to combat a virus without having to introduce the virus itself. The problem to be solved was this: The introduction of foreign mRNA ordinarily induces an innate immune system response, causing the body to destroy the mRNA before it can be processed by the body’s ribosomes. The claimed invention proposes a solution to that problem. It describes vaccine compositions (and methods of administering such compositions) in which the uridine nucleosides¹ have been replaced

¹ Nucleosides are nucleobases attached to a sugar. The four mRNA nucleobases are adenine, guanine, cytosine, and uracil. The corresponding nucleosides are adenine, guanine, cytosine, and uridine. A ribosome will translate different sequences of nucleosides (and their corresponding nucleobases) into different proteins.

with a modified form of uridine. This substitution substantially reduces the body's innate immune system response to the mRNA.

Claims 1 and 2 of the '574 patent are representative:

1. A method of producing a polypeptide of interest in a cell in a subject in need thereof, comprising administering to the subject a pharmaceutical composition comprising a modified messenger RNA (mmRNA) such that the mmRNA is introduced into the cell, wherein the mmRNA comprises a translatable region encoding the polypeptide of interest and comprises the modified nucleoside 1-methyl-pseudouridine, and wherein the pharmaceutical composition comprises an effective amount of the mmRNA providing for increased polypeptide production and substantially reduced innate immune response in the cell, as compared to a composition comprising a corresponding unmodified mRNA.

2. A pharmaceutical composition comprising:

a plurality of lipid nanoparticles comprising a cationic lipid, a sterol, and a PEG-lipid,

wherein the lipid nanoparticles comprise an mRNA encoding a polypeptide, where in the mRNA comprises one or more uridines, one or more cytidines, one or more adenosines, and one or more guanosines and wherein substantially all uridines are modified uridines.

The '600 patent, which issued on July 7, 2020, and the '127 patent, which issued on March 2, 2021, are identically entitled "Betacoronavirus mRNA Vaccine." The patents list the same inventors, share a specification and priority date, and set out substantially similar claims. Accordingly, the

court will cite to the '600 patent except in the rare instances in which the patents differ in some material respect.

The patents are directed to mRNA vaccines specifically targeting betacoronaviruses.² Claim 1 of the '600 patent and claim 1 of the '127 patent are representative.³ Claim 1 of the '600 patent reads:

1. A composition comprising: a messenger ribonucleic acid (mRNA) comprising an open reading frame encoding a betacoronavirus (BetaCoV) S protein or S protein subunit formulated in a lipid nanoparticle.

And claim 1 of the '127 patent reads:

1. A method comprising administering to a subject a messenger ribonucleic acid (mRNA) comprising an open reading frame encoding a betacoronavirus (BetaCoV) S protein or S protein subunit formulated in a lipid nanoparticle in an effective amount to induce in the subject an immune response to the BetaCoV S protein or S protein subunit, wherein the lipid nanoparticle comprises 20-60 mol % ionizable cationic lipid, 5-25 mol % neutral lipid, 25-55 mol % cholesterol, and 0.5-15 mol % PEG-modified lipid.

The parties dispute the following claim terms:

- “mRNA”
- “unmodified mRNA”

² A betacoronavirus, as will be later explained in more detail, is one of four genera of enveloped, positive-strand RNA coronaviruses that infect mammals.

³ The '600 patent claims compositions, whereas the '127 patent claims methods of administering a composition.

- “betacoronavirus”
- “S protein”
- “open reading frame”

DISCUSSION

Claim construction is a matter of law. *See Markman*, 517 U.S. at 388-389. Claim terms “are generally given [the] ordinary and customary meaning” that would be ascribed by a person of ordinary skill in the art in question at the time of the invention.³ *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-1313 (Fed. Cir. 2005) (en banc), quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996). In determining how a person of ordinary skill in the art would have understood the claim terms at the time of the invention, the court looks to the specification of the patent, its prosecution history, and, in limited instances where appropriate, extrinsic evidence such as dictionaries, treatises, or expert testimony. *Id.* at 1315-1317. Ultimately, “[t]he construction that stays true to the claim language and most naturally aligns with the patent’s

³ The parties’ experts agree that a skilled artisan would have an advanced degree and several years of experience and be part of a larger research team. *See* Ho. Decl. [Dkt # 75] ¶ 14; Griffin Decl. [Dkt # 76-4] ¶¶ 17-19.

description of the invention will be, in the end, the correct construction.”
Id. at 1316, quoting *Renishaw PLC v. Marposs Societa’ per Azioni*, 158
F.3d 1243, 1250 (Fed. Cir. 1998).

“*mRNA*”

Moderna initially proposed the following definition of mRNA:
“messenger RNA, *i.e.*, a ribonucleic acid (RNA) polynucleotide that encodes
a polypeptide of interest and can be translated to produce the encoded
polypeptide of interest.” Pfizer and BioNTech, for their part, suggested that
mRNA is “messenger ribonucleic acid, *i.e.*, a ribonucleic acid (RNA) that acts
as a template for protein synthesis through the process of translation.” In
the wake of the parties’ responsive briefing and concessions during the
Markman hearing,⁴ however, the only dispute that remains is whether
mRNA “acts as a template for encoding” a polypeptide or merely “encodes”
and “can be translated to produce” a polypeptide. *See* Defs.’ Resp. Br. [Dkt
96] at 6-7; Pls.’ Resp. Br. [Dkt # 94] at 5-6.

The court finds the latter construction to be more consistent with the
intrinsic record. The specification is rife with references to mRNA encoding
a polypeptide and being translated to produce that polypeptide. *See, e.g.*,

⁴ During the oral argument, Moderna agreed to the deletion of the
modifier “of interest” from its proposed construction.

'574 patent, col. 5, ll. 11-12; *id.*, col. 5, ll. 41-42; *id.*, col. 27, ll. 49-52; *id.*, col. 27, ll. 65-67; *id.*, col. 28, ll. 7-8. Defendants' "acts as a template for encoding" language, in contrast, is entirely missing from the text.⁵

To the extent that Pfizer and BioNTech seek to overcome this absence by pointing to the testimony of Moderna's expert, Dr. David Ho, or contemporaneous dictionary definitions, *see* Ho Dep. [Dkt # 96-1] at 73:10-12; Ex. H to Defs.' Opening Br. [Dkt # 76-8] at 5; Ex. I to Defs.' Opening Br. [Dkt # 76-9] at 4, their efforts are misdirected. Sources extrinsic to the patent cannot be used to import limitations when "the appropriate definition can be ascertained from the specification." *See Kaneka Corp. v. Xiamen Kingdomway Grp. Co.*, 790 F.3d 1298, 1305 (Fed. Cir. 2015); *see also Sinorgchem Co., Shandong v. Int'l Trade Comm'n*, 511 F.3d 1132, 1138 (Fed. Cir. 2007) ("When the specification explains and defines a term used in the claims, without ambiguity or incompleteness, there is no need to search further for the meaning of the term."), quoting *Multiform Desiccants, Inc. v. Medzam, Ltd.*, 133 F.3d 1473, 1478 (Fed. Cir. 1998). The court accordingly

⁵ Defendants correctly note that the '574 patent's definition of "expression" mentions an "RNA template." The term, however, is only used in the context of "produc[ing] an RNA template *from a DNA sequence*." '574 patent, col. 48, ll. 66-67 (emphasis added). Other language (*e.g.*, "RNA transcript" or "translation of an RNA") is used to describe mRNA in the protein expression context. *See id.*, col. 48, l. 67; *id.*, col. 49, l. 2.

cannot rely on these sources as a persuasive basis for adopting defendants' construction.⁶

“unmodified mRNA”

The parties agree that the specification defines “unmodified” as “any substance, compound or molecule prior to being changed in any way.” ’574 patent, col. 54, ll. 64-66. Their disagreement concerns whether the definition also includes the later sentence that “[m]olecules may undergo a series of modifications whereby each modified molecule may serve as the ‘unmodified’ starting molecule for a subsequent modification.” *Id.*, col. 54, l. 66-col. 55, l. 3.

The court agrees with Pfizer and BioNTech that the disputed sentence provides important context for understanding what it means to be unmodified. It “broaden[s] . . . the definition set forth in the first sentence,” clarifying that the crux of the matter is that the mRNA be unchanged in the specific manner claimed by the patent, not necessarily that it be unchanged in *all* respects.⁷ *Enanta Pharms., Inc. v. Pfizer, Inc.*, 2023 WL 3269647, at

⁶ While the court finds nothing objectionable about the term “template,” the term adds nothing of value to an understanding of the claim term.

⁷ For example, pseudouridine, which is a modified form of uridine, may serve as the “unmodified” comparator for 1-methyl-pseudouridine.

*4 (D. Mass. May 5, 2023). The definition, however, is incomplete and could confuse the jury without the intervening transitional sentence that “[u]nmodified may, but does not always, refer to the wild type or native form of a biomolecule.” ’574 patent, col. 54, ll. 66-67; see *Stragent, LLC v. BMW of N. Am., LLC*, 2022 WL 3212081, at *4 (D. Del. Aug. 9, 2022) (“[T]he Court will not call-out one particular embodiment and run the risk that the jury will view that particular embodiment as a requirement.”). The court accordingly adopts the entire paragraph as definitional.⁸

“betacoronavirus”

The parties agree that a betacoronavirus is “an enveloped, positive-sense, single stranded RNA virus of zoonotic origin that belongs to one of the four lineages of the betacoronavirus genus of the subfamily Coronavirinae (e.g., OC43, HKU1, MERS-CoV, and SARS-CoV).” They dispute, however, whether this term encompasses betacoronaviruses that came into existence after the patent’s filing date (October 21, 2016).

Whether the claim term contains a temporal limitation hinges on “the *meaning* of the term to a person of ordinary skill at the time of the

⁸ During the *Markman* hearing, Pfizer and BioNTech did not object to the court adopting a construction that includes all three sentences, and Moderna indicated it would be preferable to adopting defendants’ two-sentence construction.

invention.” *Bd. of Tr. of Leland Stanford Junior Univ. v. Roche Molecular Sys., Inc.*, 528 F. Supp. 2d 967, 980 (N.D. Cal. 2007) (emphasis in original). The court accordingly must determine whether a skilled artisan would have understood “betacoronavirus” to refer to the specific subset of viruses then in existence or a larger category of viruses, “the contents of which [might] expand over time.” *Id.*; see also *Innogenetics, N.V. v. Abbott Lab’ys*, 512 F.3d 1363, 1371-1372 (Fed. Cir. 2008); *SuperGuide Corp. v. DirecTV Enters., Inc.*, 358 F.3d 870, 878-880 (Fed. Cir. 2004); *Schering Corp. v. Amgen Inc.*, 222 F.3d 1347, 1353-1354 (Fed. Cir. 2000).

The intrinsic record favors a more expansive view. The claims lack any explicit incorporation of a temporal limitation, and nothing in the relevant definitional paragraph independently compels the conclusion that, as used in the claims, the term is meant to exclude betacoronaviruses discovered or developing post-filing.⁹ To the contrary, the definition is written in the type of broad language a skilled artisan would expect to denote an open-ended category. The court also finds it significant that the usage of the term “betacoronavirus” throughout the specification is consistent with the term

⁹ Although defendants point to use of the word “are” in the definition, they were unable, when asked during the *Markman* hearing, to identify a single case standing for the proposition that use of the word “are” implies the existence of a temporal limitation.

having a wide, unbounded scope.¹⁰ For example, the specification explicitly states that “[o]ther betacoronaviruses are encompassed by the present disclosures,” ’600 patent, col. 8, ll. 2-3, and that “[t]he present disclosure is not limited by a particular strain,” *id.*, col. 35, ll. 45-47; *see also id.*, col. 36, ll. 29-31.

That the patent examiner interpreted the claims as being directed to only those betacoronaviruses that were known to exist as of October 21, 2016, does not give the court any pause.¹¹ While, in certain circumstances, an examiner’s interpretation might shed light on how a skilled artisan would have understood a term at the time an application was filed, it cannot overcome the clear import of the specification and the claim language.

“S protein”

Moderna proposes defining “S protein” simply as “spike protein.” Pfizer and BioNTech, although not disagreeing that S protein stands for spike

¹⁰ In contrast, in *Schering*, although broader categorical language was later inserted into the claims, the specification itself disclosed only a single type of polypeptide and did not contemplate the possibility of other types.

¹¹ Because Moderna contemporaneously disputed that the claims included any such limitation, a finding of disclaimer is inappropriate. *See Biogen Idec, Inc. v. GlaxoSmithKline LLC*, 713 F.3d 1090, 1096 (Fed. Cir. 2013).

protein,¹² seek to further define the term as “a structural protein encoded by a betacoronavirus genome that mediates virus binding to cells and virus entry via fusion of the virus and target cell membranes.”

The court will adopt Moderna’s construction (with the further elaboration that “spike protein” is “a structural protein forming a spike” to address defendants’ concerns of possible jury confusion). The only support Pfizer and BioNTech cite for their proposed virus binding and entry functionality description is a passage explaining how MERS-CoV replicates in the body during infections. *See* ’600 patent, col. 34, ll. 53-59. The means by which S protein facilitates the infection of humans with a live betacoronavirus, however accurately described by Pfizer and BioNTech, holds limited relevance to how S protein operates in the context of the claimed invention.¹³ *See Sequoia Tech., LLC v. Dell, Inc.*, 66 F.4th 1317, 1326 (Fed. Cir. 2023) (“[A] patent’s express purpose of the invention ‘informs the proper construction of claim terms.’”), quoting *Kaken Pharm. Co. v. Iancu*, 952 F.3d 1346, 1352 (Fed. Cir. 2020); *see also Toro Co. v. White Consol.*

¹² Nor could they. The specification repeatedly equates S protein and spike protein. *See, e.g.*, ’600 Patent, col. 7, l. 26; *id.*, col. 8, l. 41.

¹³ Its functionality in the viral context may explain why researchers chose to focus on S protein rather than another betacoronavirus structural protein. However, as used in the claimed invention, S protein serves only an antigenic purpose; it indisputably does not mediate virus binding or entry.

Indus., Inc., 266 F.3d 1367, 1371-1372 (Fed. Cir. 2001) (construing a structural term in accordance with its use in the claims, not its functionality in other contexts).

“open reading frame”

Moderna contends that “open reading frame” means “in a DNA, a continuous stretch of DNA beginning with a start codon, and ending with a stop codon and encodes a polypeptide, or, in an mRNA, a corresponding stretch of mRNA.” Pfizer and BioNTech, on the other hand, argue that the term *only* refers to “a continuous stretch of DNA beginning with a start codon (e.g., methionine (ATG)), and ending with a stop codon (e.g., TAA, TAG or TGA) and encodes a polypeptide,” regardless of the context in which it is used.

The patent explicitly states that “[a]n ‘open reading frame’ is a continuous stretch of DNA beginning with a start codon (e.g., methionine (ATG)), and ending with a stop codon (e.g., TAA, TAG or TGA) and encodes a polypeptide.” ’600 patent, col. 62, ll. 50-53. The use of quotation marks in combination with the word “is” typically signifies an intent by the patentee to define a term, ending further inquiry. *See Sinorgchem*, 511 F.3d at 1138. Things become more complicated, however, when, as here, the alleged definition would operate to exclude nearly every embodiment described in

the patent and “render[] asserted claims facially nonsensical.” *Neville v. Found. Constructors, Inc.*, 972 F.3d 1350, 1357 (Fed. Cir. 2020), quoting *Becton, Dickinson & Co. v. Tyco Healthcare Grp., LP*, 616 F.3d 1249, 1255 (Fed. Cir. 2010). “A claim construction that excludes a preferred embodiment is ‘rarely, if ever, correct,’” and one that excludes *most* of the preferred embodiments and inherently conflicts with the plain text of the claims “is especially disfavored.” *Kaneka Corp.*, 790 F.3d at 1304, quoting *MBO Lab’ys, Inc. v. Becton, Dickinson & Co.*, 474 F.3d 1323, 1333 (Fed. Cir. 2007); *see also Neville*, 972 F.3d at 1357.

Review of the intrinsic record further compels the conclusion that the patentee did not intend to act as lexicographer in this instance. *See Baxalta Inc. v. Genentech, Inc.*, 972 F.3d 1341, 1347 (Fed. Cir. 2020). The purported definition is one of a series of four similar paragraphs immediately following the description of an “in vitro transcription template.” ’600 patent, col. 62, ll. 34-35; *see also id.*, col. 62, ll. 31-67. Each of these paragraphs is addressed to a different term used within the corresponding description. The most logical reading in context is that the patentee intended to elaborate on the specific embodiment referenced two paragraphs earlier. The court also finds it significant that the claims clearly contemplate mRNA open reading frames, *see, e.g., id.*, cl. 1, and

that the specification contains repeated references to such open reading frames, *see, e.g., id.*, col. 4, ll. 48-56; *id.*, col. 5, ll. 10-20 *id.*, col. 7, ll. 14-18; *id.*, col. 9, ll. 23-29. It would make little sense to claim or describe mRNA open reading frame embodiments if the patentee meant for “open reading frame” to be confined to the DNA context.¹⁴

ORDER

The claim terms at issue will be construed for the jury and for all other purposes in the pending litigation in a manner consistent with the above rulings of the court.

SO ORDERED.

/s/ Richard G. Stearns
UNITED STATES DISTRICT JUDGE

¹⁴ Although case law is clear that “courts may not redraft claims . . . to make them operable or to sustain their validity,” this situation is not one in which the claim language itself (or even the relevant portion of the specification) unambiguously dictates one interpretation. *Cf. Chef Am., Inc. v. Lamb-Weston, Inc.*, 358 F.3d 1371, 1373 (Fed. Cir. 2004).